Proof-of-Principle Space Launches from Omelek Island

Environmental Assessment

13 December 2004

U.S. Army Space and Missile Defense Command
P.O. Box 1500
Huntsville, Alabama 35807-3801

PROOF-OF-PRINCIPLE SPACE LAUNCHES FROM OMELEK ISLAND ENVIRONMENTAL ASSESSMENT

U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND

AGENCY: U.S. Army Space and Missile Defense Command

ACTION: Finding of No Significant Impact

BACKGROUND: Pursuant to the Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (40 Code of Federal Regulations [CFR] 1500-1508); 32 CFR Part 651, *Environmental Analysis of Army Actions* (Army Regulation 200-2); and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, the U.S. Army Space and Missile Defense Command (USASMDC) prepared an Environmental Assessment (EA) to analyze the environmental consequences of conducting two proof-of-principle space launches of the Falcon Launch Vehicle from Omelek Island, U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Test Site (USAKA/RTS). The Falcon Launch Vehicle Program is a venture by Space Exploration Technologies, Inc. (SpaceX) to provide space launch operations.

Since SpaceX proposes to pursue a commercial launch license, the twofold purpose of this EA is to analyze the potential effects of the Proposed Action in compliance with the National Environmental Policy Act and also for the use of the Federal Aviation Administration (FAA) in their licensing procedures. The FAA, which is a cooperating agency for this EA, will also rely on this analysis to support its environmental determination for a launch license for SpaceX for the Proof-of-Principle Space Launches program.

SpaceX is a privately held company that is developing the Falcon as a light-launch vehicle to put small spacecraft into orbit with high reliability and low cost. The Falcon is a two-stage vehicle; the first stage could be attached to a parachute and recovered, while the second stage is not intended to be recovered. The Falcon vehicle uses only liquid propellants: liquid oxygen (LOX) and kerosene. The Falcon Launch Vehicle Program is designed to require minimal time for vehicle assembly or payload processing on the launch pad; much of the assembly would be accomplished at the SpaceX facilities in El Segundo, California. The goal is to launch within a few days to one week of payload arrival at the launch site. This requires minimal time for processing the payload and minimal use of the launch pad. No additional flights are planned at this time.

The attached EA considers all potential impacts of the Proposed Action and Alternatives, including the No Action Alternative, both as solitary actions and in conjunction with other activities. This Finding of No Significant Impact (FONSI) summarizes USASMDC's evaluation of the proposed launches and alternatives.

DESCRIPTION OF THE PROPOSED ACTION: SpaceX would need to conduct limited refurbishment of existing buildings on Omelek, bring in some additional temporary buildings, and make infrastructure improvements in order to operate a launch facility for the Falcon launch

vehicle. Refurbishment activities and launch of the Falcon launch vehicle would comply with all of the USAKA Environmental Standards (UES) and the USAKA/RTS Range Safety Requirements. SpaceX proposes to construct a missile assembly building (MAB) and a new launch pad and to make minimal modifications to the existing Omelek site. The MAB construction would consist of a 12-meter by 30.5-meter (40-foot by 100-foot) concrete pad a minimum of 0.3 meter (1 foot) thick with a metal-framed "Butler" building constructed over it. The facility would be connected to the existing power system on the island. The new launch pad would include a berm to contain an accidental release of kerosene prior to launch. The berm would also be used to contain up to approximately 7,570 liters (2,000 gallons) of deluge water spray used during launch. A valved drainage system would be included in the pad to allow rainwater drainage when the pad is not in use. The water for the deluge system would be supplied from the ocean. A temporary land-based pump would be connected to an attended intake hose that would be floated into the lagoon and suspended just under the water. Lines to the spray system on the launch pad would be placed temporarily on the ground for each launch. The deluge spray would be used to keep surfaces relatively cool, at least below their respective melting points. Freshwater would be used to clean the pad and equipment prior to and after launch and for any required fire suppression.

After each proof-of-principle flight test, the deluge water remaining on the launch pad as well as water used to clean the launch pad before and after launches would be placed in a temporary evaporative pond and tested. If contaminants are found, the wastewater would be containerized and disposed of according to UES requirements. If no contaminants are found, the water would be allowed to remain in the pond and evaporate. Measures would be taken (e.g., a tent or elevated tarp cover over the pond) that would allow evaporation but also prevent access by birds that could be attracted to the standing water.

A concrete pad would be poured to support a LOX plant and storage tanks; although LOX and liquid nitrogen may be brought in from the United States. Two new mooring buoys would be added to the lagoon to the west of the two arms forming the harbor at Omelek. The buoys would be sited on sandy bottom areas using a small steel rod and shackle plate far enough away from any coral to prevent the chain and line off the pin on the bottom from abrading the coral during rise and fall of the tides. The buoys would be used to moor small powerboats when the landing craft is present. The powerboats would be used to transport personnel and cargo from Meck to Omelek and to evacuate personnel from Omelek before the launch.

The Falcon would carry small payloads consisting mostly of non-hazardous materials. However, small amounts of ordnance, such as small explosive bolts, pressurized helium, and yet-to-be-defined batteries could be used in the payloads. In the event the Falcon launch vehicle varies from its planned trajectory, the launch vehicle would be equipped with a thrust termination system, rather than a destructive flight termination system. The thrust termination system would be activated by a command from the Range Safety Officer and would disable power to the vehicle engines.

The proposed launch site could accommodate safe trajectories for almost any orbital inclination. The first Falcon mission from Omelek would be a sun-synchronous orbit (satellite passes over the same part of the earth at about the same local sun time each day) at an 800-kilometer (497-

mile) altitude with a launch azimuth of –3 degrees. The second mission would be for a 90-degree azimuth to an orbit of 685 kilometers (425 miles).

ALTERNATIVES CONSIDERED: There are four options for the locations of the facilities to be used at Omelek. Option 1 involves the construction of a new launch pad, the LOX plant, and fuel storage facilities on the east side of the island. The LOX plant would be built more than 24 meters (80 feet) from the center of the launch pad. The new MAB would be sited on the southwest quadrant of the island along with the J.A. Jones building. The launch control van would be placed on the west side of the island.

In Option 2 the launch pad and a new 4.3- by 30.5-meter (14- by 100-foot) slab to facilitate connecting the erector to the launcher would be constructed on the northern part of the island. The LOX plant would be built west of the slab more than 24 meters (80 feet) from the center of the launch pad. The fuel storage facility would be built on the east side of the slab. A new road would be required. The MAB and the J.A. Jones building would all be placed in the southwest quadrant of the island, as in Option 1. The launch control van would be placed between the MAB and the J.A. Jones building.

In Option 3 the launch pad and slab, the LOX plant, and the fuel storage facility would be built in the same sites as described in Option 2. The MAB would be built on the east side of the island. The J.A. Jones building would be placed in the southeast quadrant of the island. The launch control van would be placed in the southwest quadrant of the island in the same location used in Option 2.

In Option 4 the location of the launch pad, the LOX plant, the MAB, and the fuel storage facility would be the same as described in Option 1. The J.A. Jones building and the launch control van would be placed on the west side of the island. Option 4 is the Preferred Alternative.

The No-action Alternative was also considered. Under the No-action Alternative, the proposed Falcon launch vehicle activities would not be conducted at Omelek and SpaceX would not proceed with the modifications to the facilities on Omelek. SpaceX would not be able to demonstrate the capability/establish the infrastructure at Omelek to launch satellite payloads into orbit from USAKA/RTS.

METHODOLOGY: USASMDC analyzed the potential for impacts to air quality, airspace, biological resources, cultural resources, geology and soils, hazardous materials and waste, health and safety, infrastructure, noise, and water resources in the EA. USASMDC determined that implementation of the Proposed Action would not result in significant impacts to any of the resource areas listed above. All activities would be carried out in compliance with applicable federal and USAKA/RTS regulations and requirements.

Air Quality: Facility modifications and site preparation activities necessary for the Falcon launches would have a localized, minimal impact on air quality. Each launch is considered to be a discrete event that generates short-term impacts to the local air quality. Long-term effects resulting from launches are not expected because the launches would be infrequent and the resulting emissions would be rapidly dispersed and diluted by trade winds.

Airspace: Although site preparation activities could involve flights in and out of Bucholz Army Airfield on Kwajalein, they would not restrict access to, nor affect the use of, existing airfields and airports in the region of influence. SpaceX would coordinate Falcon launches with the Federal Aviation Administration through the USAKA/RTS Commander, which would include scheduling to avoid airspace conflicts.

Biological Resources: The Proposed Action is not likely to result in the removal of large amounts of native vegetation. Construction of the MAB under options 1, 2, and 4 would require removal of 2 to 3 small palm trees, but a few coconuts could be placed in a designated location in other areas on the island and allowed to grow if one of these options is selected. Prior to their arrival on Omelek, SpaceX personnel would be briefed on the need to respect and protect sensitive island resources, including the remaining native forest, and to avoid harassment of sensitive species. As part of this orientation, the sensitive nature of the habitat would be emphasized and personnel would be instructed to stay on existing roads and paths where possible. If either Option 1 or Option 4 is selected by the decision maker, signs would be placed on the north end of Omelek designating sensitive areas. Immediately prior to their shipment to Omelek, prefabricated buildings and all other materials would be inspected and if necessary treated for pests (e.g., rats, mice, and ants) and other non-native organisms to prevent their potential spread and introduction to other USAKA islands.
Disturbance from the launches would be brief and, based on existing analysis of prior and current launches from the region, is not expected to have a lasting impact nor a measurable negative effect on wildlife, including migratory bird populations and threatened or endangered species. Debris impact and booster drops in the open ocean are not expected to adversely affect marine mammal species. The probability is rather low that migratory whales or sea turtles would be within the areas affected. However, on the day of launch or the day before, SpaceX or USAKA/RTS personnel would fence the beach 100 meters (328 feet) on either side of the launch site just above the wave surge area (so the fence will remain in place) at a sufficient height to prevent sea turtles from hauling out at this area. After each Falcon launch, the remaining deluge water would be collected in a temporary evaporative pond and tested for contaminants. The water would be pumped into drums and removed from the island if found to be contaminated. Non-contaminated water would remain in the evaporative pond. The residual salt would be disposed of in the Kwajalein landfill.

A habitat enhancement project would be undertaken as a mitigation measure that would benefit the natural environment of Kwajalein Atoll under USAKA jurisdiction to offset the potential impacts of the Falcon Launch Vehicle Program on Omelek. An ant eradication project on Eniwetak would be performed by USAKA/RTS using methods developed and implemented in coordination with the Fish and Wildlife Service. This project would be performed in conjunction with other habitat improvement/restoration activities that will occur on Eniwetak. Use of ant bait that is noninjurious to crabs and other species could be used effectively to control invasive ant species and would produce the desired effect in a relatively short period of time.

Cultural Resources: The proposed launch pad, new facilities, and associated infrastructure would be primarily placed in areas that have been previously disturbed. Personnel involved in the proposed activities would follow requirements in the UES in handling or avoiding any cultural resources uncovered during site preparation or operation of the site. No impacts to cultural resources are anticipated.

Geology and Soils: Best Management Practices, such as regular watering of excavated material if required, would reduce the potential for soil erosion during site preparation and construction. The emission products of the Falcon launches would consist mainly of steam and carbon dioxide with no resultant impacts to area soils.

Hazardous Materials and Waste: Materials proposed for use are similar to hazardous materials already in use for other operations and would represent only a small increase in the total amount of materials to be handled and could easily be accommodated by current hazardous materials management systems. The types of hazardous wastes generated as a result of the Proposed Action would be similar to those already handled at USAKA/RTS. Hazardous waste management at USAKA/RTS would continue to be performed in accordance with the USAKA Environmental Standards.

Health and Safety: Refurbishment activities required for the Falcon Launch Vehicle Program would comply with the UES and all applicable USAKA/RTS Range Safety Requirements. At Kwajalein, as at all other USAKA/RTS locations, all operations involving explosives (including packaging and handling for movement) would require implementation of a written procedure, which has been approved by the USAKA/RTS Safety Office.

The Marshallese individuals who have written permission from USAKA to stay temporarily on Omelek while fishing from the adjacent islands of Gellinam or Eniwetak would be asked by the USAKA/RTS Commander to evacuate the launch hazard area once the Falcon missile has been brought to the Island. Two Falcon launches should not substantially affect this practice. Islands of the atoll and access to the mid-Atoll corridor are routinely closed during launch events. Once the launch has been accomplished and the associated facilities secured, the Marshallese can resume their temporary habitation. Access to Omelek would be limited to all but mission essential persons and personnel would be evacuated from the island prior to launch. Some emergency lighting will be provided around the dock area to facilitate an evacuation at night.

Infrastructure: The temporary increase in utility demand caused by Falcon activities is not expected to result in adverse affects to infrastructure on Kwajalein or Meck Island, since the number of personnel required would be within the range routinely handled by USAKA/RTS. No adverse impacts to the current transportation system are anticipated. SpaceX would provide up to two 500-kilovolt generators for power on the island. Potable water would be supplied on a weekly basis from Kwajalein. Abandoned restroom facilities and the leach field on Omelek would be refurbished as required for use during launch operations.

Noise: Noise impacts from site preparation activities to the surrounding environment would be minor. The increase in mechanical noises (pre-launch and launch) would be considered temporary. These noise levels are not anticipated to impact SpaceX personnel as they would be evacuated from the island prior to the launch. Falcon launches from Omelek would be over the open ocean and at an altitude of approximately 8 kilometers (5 miles) when it goes supersonic. The resultant sonic boom should not adversely impact any of the surrounding USAKA islands.

Water Resources: Minor construction activities would be confined within the immediate construction area in compliance with the USAKA Environmental Standards and would not impact water resources. The exhaust plume produced during launch would consist mainly of steam and carbon dioxide. The carbon dioxide, when mixed with the deluge water, would create

carbonic acid, which would then break down into bicarbonate and hydrogen ions and create a mild acid similar to a carbonated beverage. The steam produced is anticipated to have the same pH as rainwater; that, combined with the fact that most of the steam from the exhaust plume is expected to rapidly evaporate, should produce no long-term effects. Thus, no impacts to water resources should occur as a result of launch emissions.

CONCLUSION: Based on the environmental analysis in the Proof-of-Principle Space Launches from Omelek EA, USASMDC has determined that no significant impacts would occur as a result of the construction/restoration and operation of the Falcon Launch Vehicle launch site and related support facilities. Under the No-action Alternative, no environmental consequences associated with Falcon Launch Vehicle launches would occur. Preparation of an Environmental Impact Statement, therefore, is not required. The Environmental Assessment and draft Finding of No Significant Impact are available at http://www.smdcen.us/eaeisdoc/spacex.asp.

DEADLINE FOR RECEIPT OF WRITTEN COMMENTS: 21 January 2005

POINT OF CONTACT: Submit written comments or requests for a copy of the EA to:

U.S. Army Space and Missile Defense Command
Attention: SMDC-EN-V (Thomas M. Craven)
Post Office Box 1500
Huntsville, Alabama 35807-3801

PROOF-OF-PRINCIPLE SPACE LAUNCHES FROM OMELEK ISLAND ENVIRONMENTAL ASSESSMENT

U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND

ACTION: Finding of No Significant Impact

REVIEWED:

DATE: 05 Feb 05

ANNE DAUGHERTY
Lieutenant Colonel, U.S. Army
Commander
Reagan Test Site

PROOF-OF-PRINCIPLE SPACE LAUNCHES FROM OMELEK ISLAND ENVIRONMENTAL ASSESSMENT

U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND

ACTION: Finding of No Significant Impact

REVIEWED:

Timothy W. Mango DATE: 2 Feb 05

TIMOTHY W. MANGO
Lieutenant Colonel, AV
Director, Kwajalein Support Directorate

PROOF-OF-PRINCIPLE SPACE LAUNCHES FROM OMELEK ISLAND ENVIRONMENTAL ASSESSMENT

U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND

ACTION: Finding of No Significant Impact

APPROVED:

DATE: 8 Feb 05

BEVERLY M. STIPE
Colonel, U.S. Army
Commander
U.S. Army Kwajalein Atoll

Proof-of-Principle Space Launches from Omelek Island
Environmental Assessment
Errata

1. Page es-1, second paragraph, third sentence: Change “fuels” to “propellants”

2. Page es-5, second paragraph, third sentence: “…palm trees; however, a few coconuts could be placed in a designated location in other areas on the island and allowed to grow if one of these options is selected....”

3. Page 1-1, first paragraph, third sentence: Change “fuels” to “propellants”

4. Page 1-6, section 1.3.1, Add the following to end of paragraph:

Since SpaceX proposes to pursue a commercial launch license, the twofold purpose of this EA is to analyze the potential effects of the Proposed Action in compliance with NEPA and also for the use of the Federal Aviation Administration (FAA) in their licensing procedures.

3. Page 1-6, Add following to section 1.4:

The FAA, which is a cooperating agency for this EA, will also rely on this analysis to support its environmental determination for a launch license for SpaceX for the Proof-of-Principle Space Launches program. At the conclusion of this environmental review process the FAA will issue a separate environmental decision to support its licensing determination. The FAA will draw its own conclusions from the analysis presented in this EA and assume responsibility for its environmental decision and any related mitigation measures. In order for the FAA to use the analysis in this EA it must meet the requirements of FAA Order 1050.1 D, *Policies and Procedures for Considering Environmental Impacts*, which describes the FAA’s procedures for implementing NEPA.

4. Page 1-6, New Section 1.5:

1.5 COOPERATING AGENCY

The FAA, Office of the Associate Administrator for Commercial Space Transportation is a cooperating agency because of its regulatory authority in licensing the operation of commercial launches, as defined in 49 USC Subtitle IX Chapter 701—Commercial Space Launch Activities, and supporting regulations. The FAA is responsible for providing oversight and coordination for licensed launches and protecting the public health and safety, safety of property, and national security and foreign policy interests of the United States. Licensing of launches and reentries, operating a launch or reentry site, or some combination, is considered a federal action for which environmental impacts must be considered as part of the decision making process as required by NEPA. SpaceX will apply for a launch site operator license for one of its two planned launches.

5. Page 1-6, Revise heading to:

1.6 RELATED ENVIRONMENTAL DOCUMENTATION

6. Page 4-1, Add following to end of second paragraph:

Implementation of Options 1, 2, 3, or 4 would result in the same or very similar impacts to air quality; cultural resources; geology and soils; hazardous materials and waste; health and safety; infrastructure; noise; and water resources. Thus no separate distinction is made among the options in the analysis of these resources. Distinction is made among the options as applicable in the analysis of potential impacts to biological resources.

7. Page 4-5, last paragraph, second sentence: "…palm trees (Sims, 2004c), a few coconuts could be placed in a designated location in other areas on the island and allowed to grow …"

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19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

The U.S. Army Space and Missile Defense Command proposes to analyze the impacts of launches of two proof-of-principle Falcon launch vehicles with satellite payloads from the Island of Omelek, at the U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS). The Falcon Launch Vehicle Program is a commercial venture by Space Exploration Technologies, Inc. (SpaceX) to provide space launch operations.

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22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE *(Include Area Code)*	22c. OFFICE SYMBOL
Mr. Thomas M. Craven	(256) 955-1533	SMDC-EN-V

EXECUTIVE SUMMARY

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Introduction

This Environmental Assessment (EA) has been prepared by the U.S. Army Space and Missile Defense Command (USASMDC) to analyze the impacts of launches of two proof-of-principle Falcon launch vehicles with satellite payloads from Omelek Island at the U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS). The Falcon Launch Vehicle Program is a venture by Space Exploration Technologies, Inc. (SpaceX) to provide space launch operations.

SpaceX is a privately held company that is developing the Falcon as a light-launch vehicle to put small spacecraft into orbit with high reliability and low cost. The Falcon is a two-stage vehicle; the first stage could be attached to a parachute and recovered, while the second stage is not intended to be recovered. The Falcon vehicle uses only liquid fuels: liquid oxygen (LOX) and kerosene. The Falcon Launch Vehicle Program is designed to require minimal time for vehicle assembly or payload processing on the launch pad; much of the assembly would be accomplished at the SpaceX facilities in El Segundo, California. The goal is to launch within a few days to one week of payload arrival at the launch site. This requires minimal time for processing the payload and minimal use of the launch pad. No additional flights are planned at this time. If other launches are proposed after the conclusion of the two proof-of-principle launches, additional environmental documentation would be prepared as required.

Proposed Action

Launch activities have not been conducted at Omelek since 1996. Therefore, SpaceX would need to conduct limited refurbishment of existing buildings on Omelek, bring in some additional temporary buildings, and make infrastructure improvements in order to operate a launch facility for the Falcon launch vehicle. Refurbishment activities and launch of the Falcon launch vehicle would comply with all of the USAKA Environmental Standards (UES) and the USAKA/RTS Range Safety Requirements.

The Falcon would carry small payloads consisting mostly of non-hazardous materials. However, small amounts of ordnance, such as small explosive bolts, pressurized helium, and yet-to-be-defined batteries could be used in the payloads. In the event the Falcon launch vehicle varies from its planned trajectory, the launch vehicle would be equipped with a thrust termination system, rather than a destructive flight termination system. The thrust termination system would be activated by a command from the Range Safety Officer and would disable power to the vehicle engines.

SpaceX proposes to construct a missile assembly building (MAB) and a new launch pad and to make minimal modifications to the existing Omelek site, such as building and pier refurbishment. Although a concrete pad would be poured to support a LOX plant and storage tanks, LOX and liquid nitrogen may be brought in from the United States. In addition, the J.A. Jones building would be relocated from Roi Namur Island to Omelek to be used as the SpaceX office facility. Two new mooring buoys would be added to the lagoon to the west of the two arms forming the harbor at Omelek. The buoys would be sited on sandy bottom areas using a small steel rod and shackle plate far enough away from any coral to prevent the chain and line off the pin on the bottom from abrading the coral during rise and fall of the tides. The buoys would be used to moor small powerboats when the landing craft is present. The powerboats

would be used to transport personnel and cargo from Meck Island to Omelek and to evacuate personnel from Omelek before the launch. A new walkway from the pier to the island would be added as well as other minor pier refurbishments, which would not expand the existing pier footprint. Some emergency lighting would be provided around the dock area to facilitate an evacuation at night. A small floating dock would be installed underneath the existing pier walkway to allow small craft to access the island and not to interfere with larger craft ability to tie up to the pier. This dock would be attached to two of the upright I-beam structures in a manner to allow the dock to rise and fall with the tides and wave action. A walkway from the dock to the riprap would be installed as well as steps connecting to the walkway being renovated on top of the riprap.

The MAB construction would consist of a 12-meter by 30.5-meter (40-foot by 100-foot) concrete pad a minimum of 0.3 meter (1 foot) thick with a metal-framed "Butler" building constructed over it. The facility would be connected to the existing power system on the island.

The new launch pad would include a berm to contain an accidental release of kerosene prior to launch. The berm would also be used to contain up to approximately 7,570 liters (2,000 gallons) of deluge water spray used during launch. A valved drainage system would be included in the pad to allow rainwater drainage when the pad is not in use. The water for the deluge system could be supplied from the ocean. A land-based pump would be connected to an attended intake hose that would be floated into the lagoon and suspended just under the water. Lines to the spray system on the launch pad would be placed temporarily on the ground for each launch. Approximately 35 to 50 percent of the deluge water would be reduced to steam. The deluge spray would be used to keep surfaces relatively cool, at least below their respective melting points.

The proposed launch site can accommodate safe trajectories for almost any orbital inclination. The first Falcon mission from Omelek would be a sun-synchronous orbit (satellite passes over the same part of the earth at about the same local sun time each day) at an 800-kilometer (497-mile) altitude with a launch azimuth of –3 degrees. The second mission would be for a 90-degree azimuth to an orbit of 685 kilometers (425 miles). These two trajectories represent the most common azimuths expected to be used from USAKA/RTS. Some limited maneuvering would be possible if necessary to avoid sensitive areas.

The back-out crew that accomplishes all the on-Omelek tasks in the 4 hours or so prior to launch would be located at Meck for both mission abort operations and post-flight operations. This crew would arrive and depart Meck by boat and would be in communication with the launch organization. After launch and approval by ground safety, the crew would approach Omelek and begin post-launch procedures. All equipment except for the LOX plant, diesel storage container, SpaceX office facility, and the water storage containers would be removed after the launch operation. Kerosene and the helium storage trailer would be removed from the island after completion of the mission. The LOX and liquid nitrogen would be allowed to boil off, and the plant would be secured. Facilities at Omelek would be cleaned and prepared for storage within approximately 7 days.

There are four options for the locations of the facilities to be used at Omelek. Option 1 involves the construction of a new launch pad, the LOX plant, and fuel storage facilities on the east side of the island. The LOX plant would be built more than 24 meters (80 feet) from the center of the launch pad. The new MAB would be sited on the southwest quadrant of the island along with the J.A. Jones building. The launch control van would be placed on the west side of the island.

In Option 2 the launch pad and a new 4.3- by 30.5-meter (14- by 100-foot) slab to facilitate connecting the erector to the launcher would be constructed on the northern part of the island. The LOX plant would be built west of the slab more than 24 meters (80 feet) from the center of the launch pad. The fuel storage facility would be built on the east side of the slab. A new road would be required. The MAB and the J.A. Jones building would all be placed in the southwest quadrant of the island, as in Option 1. The launch control van would be placed between the MAB and the J.A. Jones building.

In Option 3 the launch pad and slab, the LOX plant, and the fuel storage facility would be built in the same sites as described in Option 2. The MAB would be built on the east side of the island. The J.A. Jones building would be placed in the southeast quadrant of the island. The launch control van would be placed in the southwest quadrant of the island in the same location used in Option 2.

In Option 4 the location of the launch pad, the LOX plant, the MAB, and the fuel storage facility would be the same as described in Option 1. The J.A. Jones building and the launch control van would be placed on the west side of the island. Option 4 is the Preferred Alternative.

No-action Alternative

Under the No-action Alternative, the proposed Falcon launch vehicle activities would not be conducted at Omelek and SpaceX would not proceed with the modifications to the facilities on Omelek. SpaceX would not be able to demonstrate the capability/establish the infrastructure at Omelek to launch satellite payloads into orbit from USAKA/RTS.

Methodology

To assess the significance of any impact, a list of activities necessary to accomplish the Proposed Action was developed. The affected environment at all applicable locations was then described. Next, those activities with the potential for environmental consequences were identified. The degree of analysis of proposed activities is proportionate to their potential to cause environmental impacts.

Thirteen broad areas of environmental consideration were originally considered to provide a context for understanding the potential effects of the Proposed Action and to provide a basis for assessing the severity of potential impacts. These areas included air quality, airspace, biological resources, cultural resources, environmental justice, geology and soils, hazardous materials and waste, health and safety, infrastructure, land use, noise, socioeconomics, and water resources. These areas were analyzed as applicable for the proposed location or activity.

Results

Based on an initial analysis, it was determined that the activities proposed would not result in impacts to land use of USAKA/RTS. Omelek would remain under U.S. Army management and would continue to be used for missile research. The Proposed Action is consistent with the mission of the island and would not conflict with any known land use plans, policies, or controls.

The back-out crew located on Meck for both mission abort and post-flight operations would use existing facilities with no potential for environmental impacts. Temporary storage of the Falcon launch vehicle components on Kwajalein Island would also be accomplished using facilities that

currently handle similar items. Resources with a potential for impacts from this temporary storage would be hazardous materials and waste and health and safety.

Only a few existing base personnel would be involved, and only 20 SpaceX personnel would require lodging on Kwajalein Island; thus, there would be no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts to any minority or low-income populations under Executive Order 12898 (Environmental Justice) or environmental health and safety risks that may disproportionately affect children under Executive Order 13045 (Federal Actions to Address Protection of Children from Environmental Health and Safety Risks) would not occur.

For purposes of this analysis, open ocean refers to those ocean areas beyond U.S. and Republic of the Marshall Islands territorial limits. Open ocean areas are subject to Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. A limited number of resources could potentially be affected in open ocean areas by the Proposed Action including airspace, biological resources, and health and safety. Noise and water impacts are relevant only with respect to effects on biological resources.

This section summarizes the conclusions of the analyses made for each of the areas of environmental consideration based on the application of the described methodology.

Air Quality

The overall impact to the ambient air at Omelek and other USAKA islands providing support to the Proposed Action is expected to be minimal. Facility modifications and site preparation activities necessary for the Falcon launches would have a localized, minimal impact on air quality.

The possible exhaust emissions associated with the proposed two 500-kilovolt generators would be considerably below the current threshold levels and thus are not anticipated to impact the regional air quality or exceed the existing ambient air quality standards. Any kerosene or LOX spills that occur during the fueling process would be contained and cleaned up in accordance with the USAKA/RTS spill containment procedures, and therefore are anticipated to have no contribution to the overall emissions generated during the flight test activities. Each launch is considered to be a discrete event that generates short-term impacts to the local air quality. Long-term effects resulting from launches are not expected because the launches would be infrequent and the resulting emissions would be rapidly dispersed and diluted by trade winds.

Airspace

USAKA/RTS is located under international airspace and, therefore, has no formal airspace restrictions governing it. Although site preparation activities could involve flights in and out of Bucholz Army Airfield on Kwajalein, they would not restrict access to, nor affect the use of, existing airfields and airports in the region of influence. Operation at the airfield would continue unobstructed. Similarly, the existing airfield or airport arrival and departure traffic flows would not be affected. No modification to or new requirements for special use airspace would be required. No changes to existing air routes or additional restricted access to regional airfields and airports are anticipated. All arriving and departing aircraft and all participating military aircraft are under the control of the Bucholz Army Airfield Control Tower; thus, there would be no airfield conflicts in the region of influence, and no effect.

Commercial and private aircraft would be notified in advance of Falcon launch activities by USAKA/RTS as part of their routine operations through Notices to Airmen by the Federal Aviation Administration. Because the airspace in the open ocean area around Kwajalein Atoll is not heavily used by commercial aircraft, the impacts to airways and jet routes that crisscross the Ocean Area airspace use region of influence are expected to be minimal. SpaceX would coordinate Falcon launches with the Federal Aviation Administration through the USAKA/RTS Commander, which would include scheduling to avoid airspace conflicts. The Proposed Action activities would not occur at the same time as Ground-Based Midcourse Defense activities.

Biological Resources

The Proposed Action is not likely to result in the removal of large amounts of native vegetation. The proposed new construction and associated infrastructure would be primarily placed in areas where vegetation is currently maintained at a low level by mowing or other mechanical control. Construction of the MAB under options 1, 2, and 4 would require removal of two to three small palm trees; however, young replacement trees would be planted in other areas of the island. No threatened or endangered vegetation species have been identified in the project areas. If either Option 1 or Option 4 is selected by the decision maker, signs would be placed on the north end of Omelek designating sensitive areas. Prior to their arrival on Omelek, SpaceX personnel would be briefed on the need to respect and protect sensitive island resources, including the remaining native forest, and to avoid harassment of sensitive species. Personnel would be instructed to stay on existing roads and paths where possible. Onsite supervisors would ensure that personnel comply with the briefing objectives.

On the day of the launch or the day before, SpaceX or USAKA/RTS personnel would install fencing 100 meters (328 feet) on either side of the launch site just above the wave surge area at a sufficient height to prevent sea turtles from hauling out on the beach adjacent to the launch site and thus would prevent a take during a nominal launch. Personnel would be instructed to avoid areas designated as bird nesting or roosting habitat and to avoid all contact with any nest that may be encountered. Immediately prior to their shipment to Omelek, prefabricated buildings and all other materials would be inspected by a certified pest control inspector and, if necessary, treated for the removal of pests (e.g., rats, mice, and ants) and other non-native organisms to prevent their potential spread and introduction to other USAKA islands. Although construction activities could cause flushing (birds suddenly flying up), this is a common reaction to sudden natural sounds that only slightly increases the energy expenditure of individual birds. Some wildlife may leave the area permanently, while others may likely become accustomed to the increased noise and human presence. Emergency lighting would be shielded and pointed down to minimize the potential for impacts to migratory birds and sea turtles.

Disturbance from the launches would be brief and, based on existing analysis of prior and current launches from the region, is not expected to have a lasting impact nor a measurable negative effect on wildlife, including migratory bird populations and threatened or endangered species. The exhaust plume produced by the Falcon launch vehicle would consist mainly of steam and carbon dioxide. The carbon dioxide, when mixed with the deluge water, would create carbonic acid, a mild acid similar to a carbonated beverage. The steam produced is anticipated to have the same pH as rainwater. Most of the steam from the exhaust plume is expected to evaporate and thus is not anticipated to have a long-term impact on biological resources in the area adjacent to the launch pad.

In the event of an accidental fuel spill or premature flight termination resulting in fuel coming in contact with seawater, fuel would be rapidly buffered by the seawater, thus preventing any significant adverse impacts. The Pacific Ocean depth in the vicinity of the launch area is thousands of meters (feet) deep, and any area affected by release of the propellant would be relatively small due to the size of the Falcon's motor or propellant relative to the quantity of seawater. Consequently, any impact from the fuel is expected to be minimal. In addition, an accident response team would be available to negate or minimize any adverse effects.

Most missile overflights are at altitudes greater than 30 meters (100 feet) in a few seconds, and the transient noise produced is not expected to exceed the acoustic disturbance criteria for marine mammals. Falcon launches from Omelek would be over the open ocean and at an altitude of approximately 8 kilometers (5 miles) when it goes supersonic. Momentary startle or alert reactions in response to a single transient sound such as a sonic boom are not considered a significant adverse effect to whales. Debris impact and booster drops in the open ocean are not expected to adversely affect marine mammal species. The probability is rather low that migratory whales or sea turtles would be within the area to be impacted by falling debris and boosters. Early flight termination could result in widely scattered debris, but the probability of this debris hitting wildlife is remote.

After each Falcon launch, the remaining deluge water would be collected in a temporary evaporative pond and tested for contaminants. The water would be pumped into drums and removed from the island if found to be contaminated. Non-contaminated water would remain in the evaporative pond. The residual salt would be disposed of in the Kwajalein landfill.

An ant eradication project on Eniwetak would be performed as a mitigation measure by USAKA/RTS using methods developed and implemented in coordination with the U.S. Fish and Wildlife Service.

Cultural Resources

The proposed launch pad, new facilities, and associated infrastructure would be primarily placed in areas that have been previously disturbed. No historic archaeological sites, World War II, or significant Cold War features have been identified on Omelek. Personnel involved in the proposed activities would follow requirements in the UES in handling or avoiding any cultural resources uncovered during site preparation or operation of the site. No impacts to cultural resources are anticipated.

Geology and Soils

Best Management Practices, such as regular watering of excavated material if required, would reduce the potential for soil erosion during site preparation and construction. The emission products of the Falcon launches would consist mainly of steam and carbon dioxide. In the unlikely event of an accidental release of kerosene, emergency response personnel would comply with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX and the Kwajalein Environmental Emergency Plan. Following these safety regulations and requirements would minimize the potential for accidental spills, as well as provide the means for mitigating or minimizing effects to soils and disposal of the recovered fuel if an accident were to occur. Any contaminated soil would be collected, removed from Omelek, and disposed of in accordance with USAKA/RTS regulations.

Hazardous Materials and Waste

Falcon launch vehicle equipment and components, including ordnance and hazardous materials, would be transported, stored, and handled in accordance with applicable USAKA/RTS and Department of Transportation regulations and military standards. These materials are similar to hazardous materials already in use for other operations and would represent only a small increase in the total amount of materials to be handled and could easily be accommodated by current hazardous materials management systems.

Hazardous waste management at USAKA/RTS would continue to be performed in accordance with the UES, which require shipment of hazardous waste back to the Continental United States for treatment and/or disposal. The types of hazardous wastes generated as a result of the Proposed Action would be similar to those already handled at USAKA/RTS.

Health and Safety

Refurbishment activities required for the Falcon Launch Vehicle Program would comply with all applicable UES and USAKA/RTS Range Safety Requirements. At Kwajalein, as at all other USAKA/RTS locations, all operations involving explosives (including packaging and handling for movement) would require implementation of a written procedure, which has been approved by the USAKA/RTS Safety Office. These operations would be conducted under the supervision of an approved ordnance officer using explosive-certified personnel. All storage and handling of explosives would take place in facilities designed to handle explosives and which have been sited in accordance with the requirements of USAKA/RTS. The explosive devices and materials proposed for use as part of the Falcon flight tests would be very similar to those currently stored and used at USAKA/RTS. The total weight of explosive ordnance on the Falcon vehicle is less than 20 grams (0.7 ounce).

The Marshallese individuals who have written permission from USAKA to stay temporarily on Omelek while fishing from the adjacent islands of Gellinam or Eniwetak would be asked by the USAKA/RTS Commander to evacuate the launch hazard area once the Falcon missile has been brought to the island. Two Falcon launches should not substantially affect this practice. Islands of the atoll and access to the mid-Atoll corridor are routinely closed during launch events. Once the launch has been accomplished and the associated facilities secured, the Marshallese can resume their temporary habitation.

Operation of the Falcon Launch Vehicle Program would comply with all UES and USAKA/RTS Range Safety Requirements. Flight safety studies would be performed to ensure that launches would not compromise range safety requirements and that risk to personnel would be within required limits. Access to Omelek would be limited to all but mission essential persons and personnel would be evacuated from the island prior to launch. The first stage and fairing would impact in the open ocean. The first stage could be attached to a parachute system and could be recovered. The second stage would go into a degrading orbit with the payload. It will eventually reenter the atmosphere, but will burn up upon reentry and it is highly unlikely that any debris would reach the earth. When containment within the debris hazard/impact zone appears impossible, risk analysis based on established USAKA/RTS Flight Safety risk equations is done to determine if the risk to the public is within acceptable limits. Use of existing sensors would continue in accordance with ongoing activities at USAKA/RTS.

In situations where Omelek must be evacuated, SpaceX will ensure that private marine transport capable of evacuating all personnel on island will be available for use. Personnel will turn off master power and move to Meck, where further instructions may be provided. Some emergency lighting will be provided around the dock area to facilitate an evacuation at night.

Infrastructure

The temporary increase in utility demand caused by Falcon activities is not expected to result in adverse affects to infrastructure on Kwajalein or Meck Island, since the number of personnel required would be within the range routinely handled by USAKA/RTS. No adverse impacts to the current transportation system are anticipated.

SpaceX would provide up to two 500-kilovolt generators for power on the island, which would be supplied to the various areas required either through existing conduits below ground, or via temporary over-ground cable trays. Some emergency lighting will be provided around the dock area to facilitate an evacuation at night. No impacts to current USAKA/RTS electricity/fuel systems are anticipated. Potable water would be supplied on a weekly basis from Kwajalein and stored in two plastic 3,785-liter (1,000-gallon) reservoirs supplied by SpaceX. Launch pad deluge water and water used to clean up the launch pad and equipment would be obtained from a seawater pump system (the pump would require its own integral 3- to 7.5-kW generator) and from freshwater supplied by SpaceX respectively. Water would not be discharged into the ocean.

Abandoned restroom facilities and the leach field would be refurbished as required for use during launch operations. The existing well system would be used for the toilets in the restroom as used previously. The limited amount of solid waste generated as a result of Falcon program site preparation would be collected for disposal in accordance with UES and USAKA/RTS requirements and regulations. No impacts to USAKA/RTS solid waste levels are anticipated.

Noise

Noise impacts from site preparation activities to the surrounding environment would be minor. The increase in mechanical noises (pre-launch and launch) would be considered temporary. These noise levels are not anticipated to impact SpaceX personnel as they would be evacuated from the island prior to the launch. Falcon launches from Omelek would be over the open ocean and at an altitude of approximately 8 kilometers (5 miles) when it goes supersonic. The resultant sonic boom should not adversely impact any of the surrounding USAKA islands.

Water Resources

Minor construction activities would be confined within the immediate construction area in compliance with the UES and would not impact water resources. The exhaust plume produced during launch would consist mainly of steam and carbon dioxide. The carbon dioxide, when mixed with the deluge water, would create carbonic acid, which would then break down into bicarbonate and hydrogen ions and create a mild acid similar to a carbonated beverage. The steam produced is anticipated to have the same pH as rainwater; that, combined with the fact that most of the steam from the exhaust plume is expected to rapidly evaporate, should produce no long-term effects. Thus, no impacts to water resources would occur as a result of launch emissions. An accident response team would be available soon after launch to negate or minimize any adverse effects from a spill or debris from a flight termination. No deluge or rinse water would be discharged back into the ocean.

Cumulative Impacts

The Proposed Action would consist of two Falcon launches. The Proposed Action activities would not occur at the same time as other programs such as Ground-Based Midcourse Defense or Minuteman III planned for the region. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. There are currently no other activities planned at Omelek. Missile launches are short-term, discrete events actively managed by USAKA/RTS range safety, thus allowing time between launches for emission products to be dispersed and minimizing the potential for impacts to airspace users, biological resources, and public health and safety. The ant eradication program proposed as a habitat enhancement on Eniwetak would have a positive cumulative impact on the natural environment of USAKA. Using the required scheduling process for international airspace would minimize the potential for cumulative impacts to the airspace above the open ocean. No significant cumulative impacts to terrestrial or marine biological resources have been identified as a result of prior launch-related activities and no cumulative impacts are expected as a result of the planned two Falcon launches. Overall avoidance would minimize the potential for cumulative cultural resources impacts. Preparation of the launch site and adherence to established hazardous waste and spill prevention procedures and regulations would minimize the potential for cumulative impacts to geology or soils.

Adherence to the hazardous materials and waste management systems of USAKA/RTS would preclude the potential accumulation of hazardous materials or waste. The UES establishes emergency response procedures that would aid in the evaluation and cleanup of any hazardous materials released. Adherence to the high safety standards at USAKA/RTS would serve to keep any cumulative safety impacts attributable to all USAKA/RTS operations within acceptable standards to both workers and the public. The additional demand on electrical, wastewater, solid waste, and water systems to support the small number of project-related transient personnel is expected to be within the current capacity of USAKA/RTS. The sound level generated by each Falcon launch would be a short, discrete event and no cumulative impacts are anticipated. Adherence to established hazardous waste and spill prevention procedures and regulations would minimize the potential for cumulative impacts to water resources.

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1.0
PURPOSE AND NEED

1.0 PURPOSE AND NEED

This Environmental Assessment (EA) has been prepared by the U.S. Army Space and Missile Defense Command (USASMDC) to analyze the impacts of launches of two proof-of-principle Falcon launch vehicles with satellite payloads from Omelek Island (figures 1-1 through 1-3), at the U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS). The Falcon Launch Vehicle Program is a venture by Space Exploration Technologies, Inc. (SpaceX) to provide space launch operations.

1.1 BACKGROUND

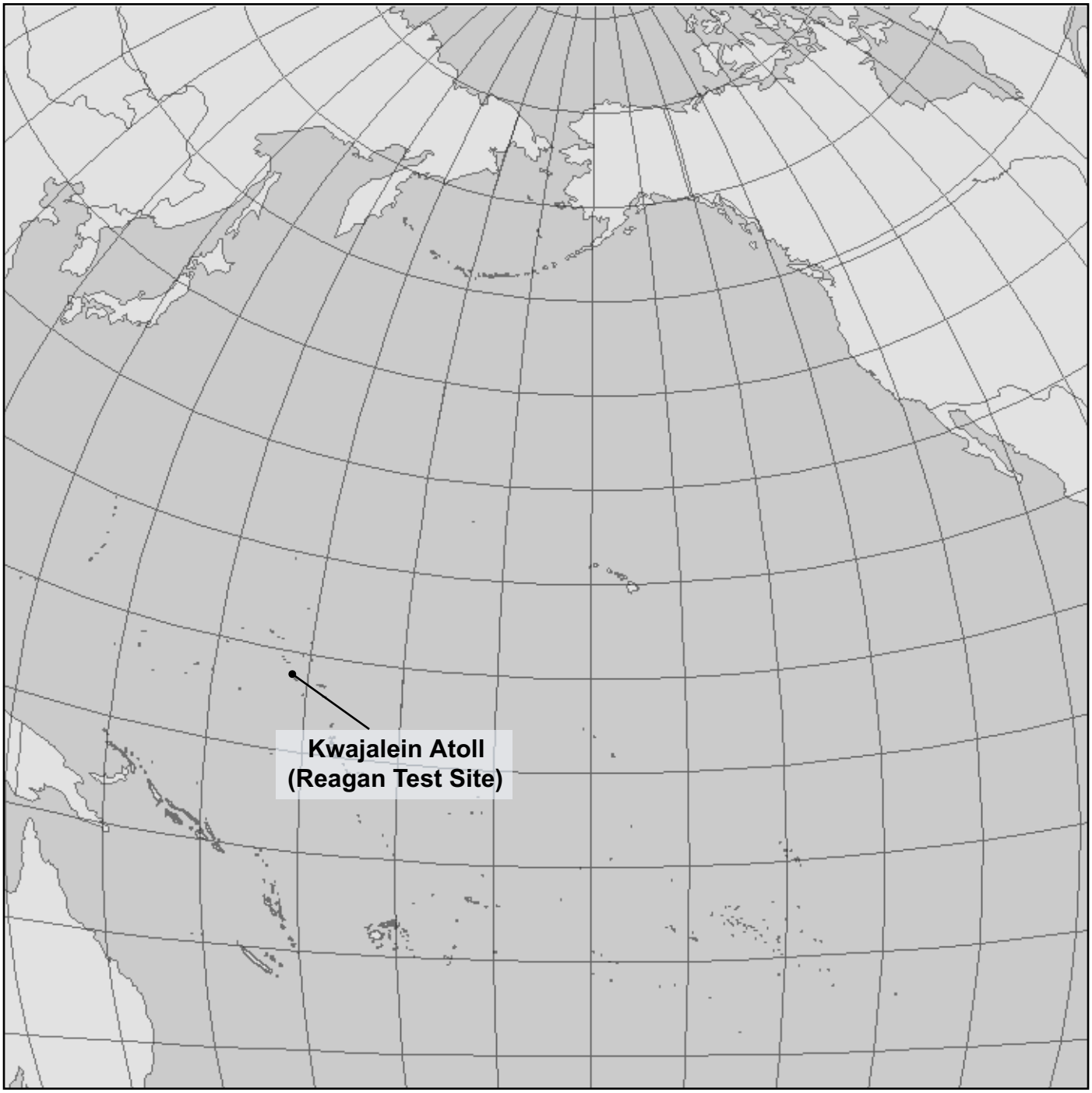
SpaceX is a privately held company that is developing the Falcon as a light-launch vehicle (figure 1-4) to put small spacecraft into orbit with high reliability and low cost. The Falcon is a two-stage vehicle; the first stage is intended to be recovered and its parts reused, while the second stage is not intended to be recovered. The Falcon vehicle uses only liquid fuels. The Falcon Launch Vehicle Program is designed to require minimal time for vehicle assembly or payload processing on the launch pad; much of the assembly would be accomplished at the SpaceX facilities in El Segundo, California. The goal is to launch within a few days to one week of payload arrival at the launch site. This requires minimal time for processing the payload and minimal use of the launch pad. At the present time SpaceX plans two proof-of-principle launches of satellite payloads from Omelek. Any subsequent Falcon launches would require additional environmental documentation.

1.2 SCOPE OF ENVIRONMENTAL ASSESSMENT

USASMDC has complied with the following statutes and regulations that direct Department of Defense (DoD) lead-agency officials to consider potential environmental consequences when authorizing or approving federal actions.

- The National Environmental Policy Act (NEPA) of 1969, as amended
- The Council on Environmental Quality regulations that implement NEPA (Code of Federal Regulations [CFR], Title 40, Parts 1500-1508)
- DoD Instruction 4715.9, *Environmental Planning and Analysis*
- Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*
- 32 CFR Part 651 *Environmental Analysis of Army Actions* (Army Regulation 200-2)
- *Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands, Eighth Edition, April 2003*

This EA describes the events necessary to conduct the proposed satellite launches from Omelek. It also presents the decision-maker with a concise analysis of anticipated environmental consequences that would result from conducting the proposed flights.



EXPLANATION

Regional Location of Kwajalein Atoll

Pacific Ocean

Not to Scale

NORTH

Figure 1-1

10-12-04 USAKA regional

EXPLANATION

Land

Coral

Kwajalein Atoll

United States Army
Kwajalein Atoll

Scale

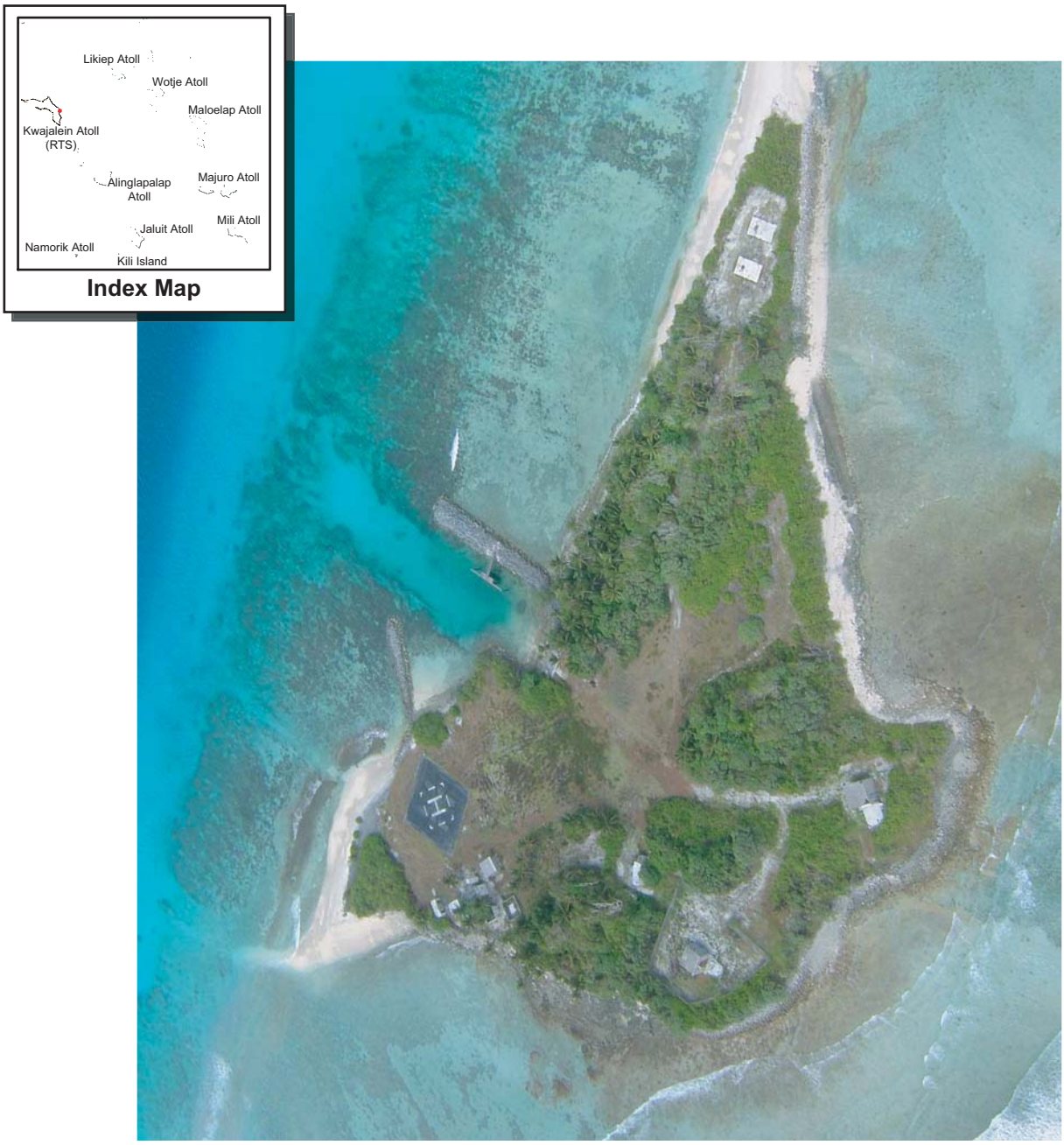
0 7.5 15 kilometers

0 4.75 9.5 miles

NORTH

10-12-04 Kwajalein Atoll

Figure 1-2



EXPLANATION

Omelek Island

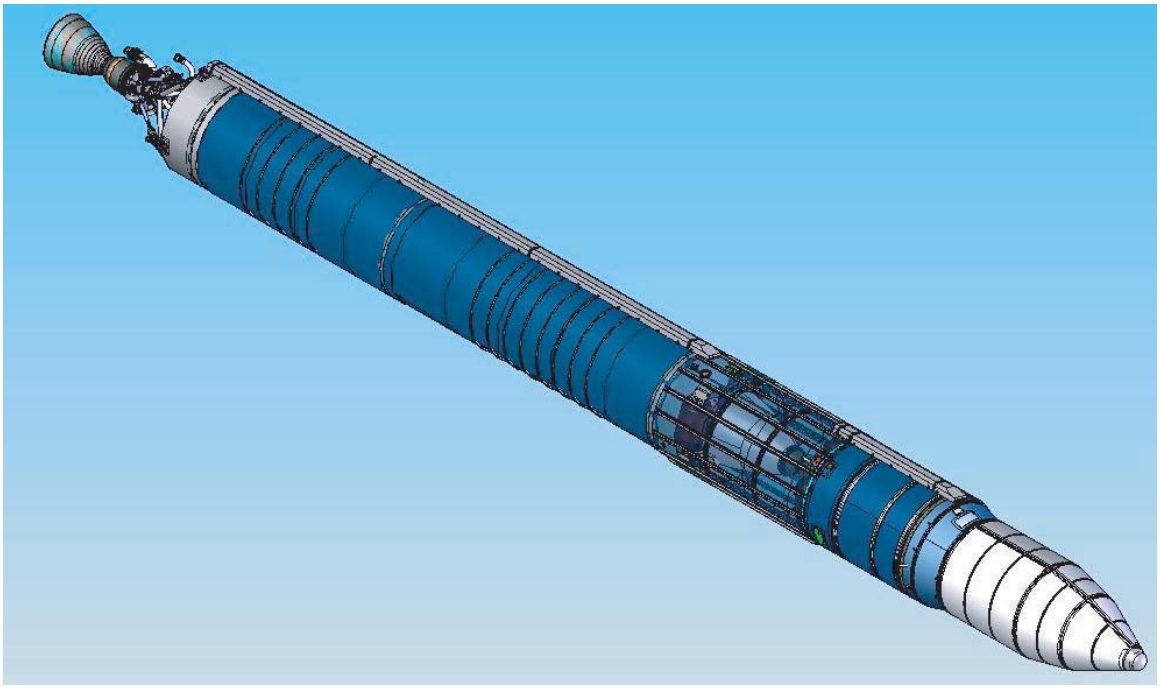
Omelek, Kwajalein Atoll

NORTH

Unknown Scale

Figure 1-3

10-12-04 Omelek Island



EXPLANATION

Falcon Launch Vehicle

Not to Scale

Figure 1-4

Actions occurring within the United States, or within the Republic of the Marshall Islands (RMI) per the Compact of Free Association, will be evaluated under NEPA. Actions occurring in the Broad Ocean Areas will be evaluated per Executive Order 12114.

1.3 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.3.1 PURPOSE

The purpose of the Proposed Action is to demonstrate the capability/establish the infrastructure at Omelek to launch satellite payloads into space from USAKA/RTS. The Falcon launch vehicle is proposed to launch the payloads.

1.3.2 NEED

The Proposed Action is needed to establish the capability at USAKA/RTS to launch satellite payloads into orbit.

1.4 DECISION TO BE MADE

Based on information presented in this EA, the USAKA/RTS Commander will decide whether to allow SpaceX to conduct the two Falcon launches from Omelek.

1.5 RELATED ENVIRONMENTAL DOCUMENTATION

As appropriate, the conclusions of these NEPA studies have been summarized and included in this document:

- *Draft Environmental Impact Statement Proposed Actions at U.S. Army Kwajalein Atoll*, June 1989
- *Final Environmental Impact Statement Proposed Actions at U.S. Army Kwajalein Atoll*, October 1989
- *Final Supplemental Environmental Impact Statement Proposed Actions at U.S. Army Kwajalein Atoll*, December 1993
- *Final Environmental Assessment for the Falcon Launch Program*, July 2003

2.0
DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action, the alternative launch locations on Omelek, the No-action Alternative, and alternatives considered but eliminated from further study.

2.1 PROPOSED ACTION

The Proposed Action is to conduct two proof-of-principle launches placing small payloads into orbit from Omelek using the Falcon launch vehicle. The two flights are expected to have satellite payloads. No additional flights are planned at this time. If other launches are proposed after the conclusion of the two proof-of-principle launches, additional environmental documentation would be required.

The Falcon, a light-lift launch vehicle, is a two-stage vehicle designed to put small spacecraft into orbit with high reliability and low cost. Only the first stage would be recoverable. The Falcon would use only the liquid propellants liquid oxygen (LOX) and RP-1, a type of kerosene commonly used as a rocket propellant (cited as kerosene in the rest of this document). No solid propellants would be used.

The Falcon launch vehicle is designed for minimal vehicle assembly or processing on the launch pad, with most of the vehicle assembly taking place at the SpaceX facilities in El Segundo, California. The Falcon launch vehicle would arrive at Kwajalein fully assembled and installed in its Transporter/Erector system. Non-hazardous payloads would be processed at Omelek also. The Falcon launch vehicle would be fueled on the pad at Omelek. Kerosene would be loaded the day before the launch, and LOX would be loaded the day of the launch. The goal is to launch within a few days to one week of payload arrival at the launch site.

Launch activities have not been conducted at Omelek since 1996. Therefore, SpaceX would need to conduct limited refurbishment of existing buildings, bring in some additional temporary buildings, and make infrastructure improvements in order to operate a launch facility for the Falcon launch vehicle. Refurbishment activities and launch of the Falcon launch vehicle would comply with all of the USAKA Environmental Standards (UES) and the USAKA/RTS Range Safety Requirements. Actions would be taken to minimize disturbance to biological resources such as using temporary above-ground cable trays to route power and communication cables, posting signs to designate sensitive areas on the island, and providing personnel with information on the need to respect and protect sensitive island resources and to avoid harassment of sensitive species.

The following sections provide descriptions of the launch vehicle, the launch operations, and alternative configurations for the launch facilities.

2.1.1 FALCON LAUNCH VEHICLE

The Falcon is a small, unmanned launch vehicle with a gross lift-off weight of approximately 27,216 kilograms (60,000 pounds). The Falcon uses LOX and kerosene to carry payloads into orbit. The first stage uses a turbo-pump to feed the propellant, while the second stage is pressure fed. Figure 2-1 shows a view of the main components of the Falcon vehicle.

First and Second Stages

The first stage consists of LOX and kerosene tanks that hold 12,708 liters (3,357 gallons) of LOX and 8,245 liters (2,178 gallons) of kerosene. The second stage consists of 2,203 liters (582 gallons) of LOX and 1,325 liters (350 gallons) of kerosene in tanks with a common bulkhead. The Falcon launch vehicle uses helium gas stored in high pressure, composite over wrapped cylinders to pressurize the propellant tanks. Quantities of helium required for Falcon processing are 16.5 kilograms (36.9 pounds) for first stage pressurization, engine spin start, and purging and 9.8 kilograms (21.7 pounds) for second stage pressurization. The helium flow is controlled through solenoid valves.

Thrust Termination System

In the event the Falcon launch vehicle varies from its planned trajectory, the launch vehicle would be equipped with a thrust termination system, rather than a destructive flight termination system. The thrust termination system would be activated by a command from the Range Safety Officer and would disable power to the vehicle engines. Once power is removed, there are up to six different valves that close and immediately shut off the first stage engine. Four valves close on the second stage, again shutting down the stage's engine. Thus, the Falcon launch vehicle would fall to the ocean intact.

Payload Description

The Falcon would carry small payloads consisting mostly of non-hazardous materials. However, small amounts of ordnance, such as small explosive bolts, pressurized helium, and yet-to-be-defined batteries, could be used in the payloads.

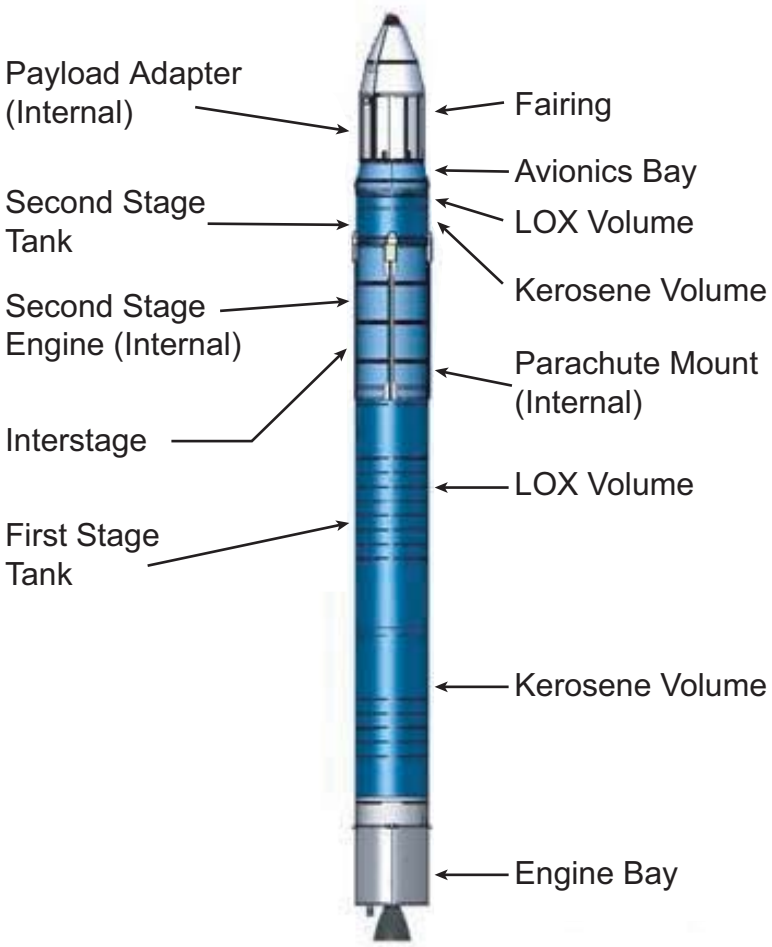
2.1.2 LAUNCH OPERATIONS

Pre-Launch Activities

Construction Activities

SpaceX proposes to construct a missile assembly building (MAB) and a new launch pad and to make minimal modifications to the existing Omelek site, such as building refurbishment. The following facilities that currently exist on Omelek would be refurbished and used for the Falcon proof-of-principle launch operations:

- Pier and harbor
- Generator building
- Communications building
- Restrooms
- Fuel storage area



EXPLANATION

Falcon Launch Vehicle Main Components

Not to Scale

Figure 2-1

These facilities would be used for their originally intended purposes. The Omelek pier is built into the embayment formed by a natural projection of the island and a constructed breakwater. The breakwater is a built up soil mound armored with large pieces of coral rock (riprap). There currently is no walkway over the top of the riprap from the pier to the island. The current pathway is potentially unsafe to walk upon. The following activities, which would not expand the existing pier footprint, would be required to refurbish the pier for use: replace three fenders on the pier; replace required deck boards; re-secure rails; construct forms to replace the 0.9-meter by 36.5-meter (3-foot by 120-foot) walkway from the pier to the shore with a walkway over the riprap; install wire mesh inside the forms; batch approximately 7 cubic meters (9 cubic yards) of concrete for the walkway; install new speedrail on the north side of the walkway (removable handrail); construct a gradual ramp from the top of the riprap to the island (existing grade difference is less than 0.6 meters [(2 feet]) touch up pier coating as necessary; and fabricate and install a facilities sign. Some supplies could be unloaded on the pier and placed on dollies for delivery. A small floating dock would be installed underneath the existing pier walkway to allow small craft to access the island and not to interfere with larger craft ability to tie up to the pier. This dock would be attached to two of the upright I-beam structures in a manner to allow the dock to rise and fall with the tides and wave action. A walkway from the dock to the riprap would be installed as well as steps connecting to the walkway being renovated on top of the riprap.

Two new mooring buoys would be added to the lagoon to the west of the two arms forming the harbor at Omelek. The buoys would be sited on sandy bottom areas using a small steel rod and shackle plate far enough away from any coral to prevent the chain and line off the pin on the bottom from abrading the coral during rise and fall of the tides. The buoys would be used to moor small powerboats when the landing craft is present. The powerboats would be used to transport personnel and cargo from Meck to Omelek and to evacuate personnel from Omelek before the launch.

SpaceX would provide up to two 500-kilovolt generators for power on the island, which would be supplied to the various areas required either through existing conduits below ground, or via temporary over-ground cable trays. Communication hook-ups from various facilities to the communications building would be temporary: either on the ground in protected conduit trays or suspended on a stand or crossed posts sunk slightly in the ground for stability. Potable water would be supplied on a weekly basis from Kwajalein and stored in two plastic 3,785-liter (1,000-gallon) reservoirs supplied by SpaceX. The reservoirs would be placed on a stand near the J.A. Jones building or the MAB.

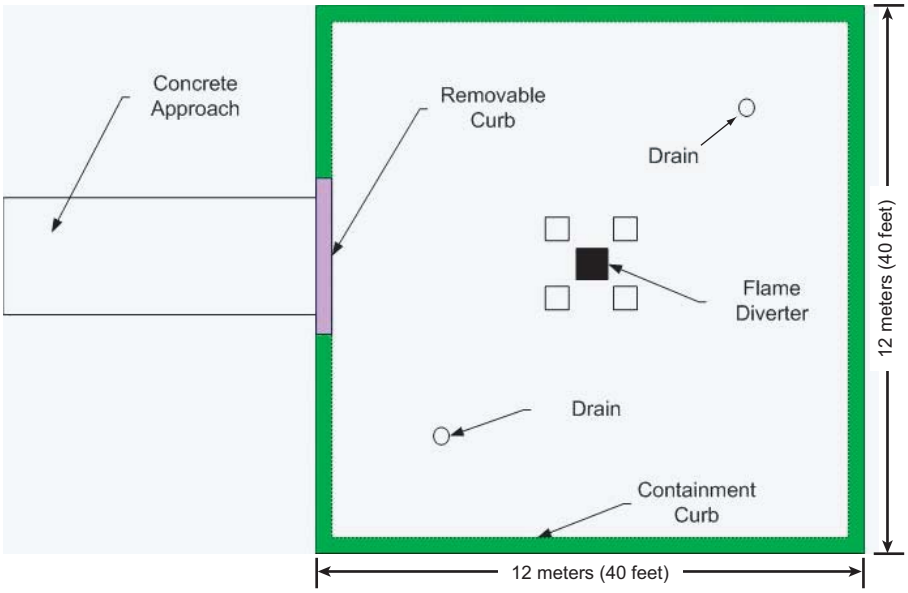
A new MAB would be constructed as part of the Proposed Action. The MAB would be used for launch vehicle preparation before launch. This building would consist of a 12-meter by 30.5-meter by 0.3-meter (40-foot by 100-foot by 1-foot) concrete pad with a metal-framed “Butler” building constructed over it. The maximum height of the facility would be 8 meters (25 feet). This facility would be connected to the power systems on the island.

In addition, the J.A. Jones building (figure 2-2) would be relocated from Roi Namur to Omelek to be used as the SpaceX office facility. A new 12-meter by 12-meter (40-foot by 40-foot) concrete launch pad a minimum of 0.3 meter (1 foot) thick and a truck access pad would be poured (figure 2-3). The launch pad would include an impermeable berm (a minimum of 5 centimeters [2 inches] high) to contain an accidental release of kerosene prior to launch. The berm would have a section of removable curb as shown in figure 2-3. Once the Falcon launch vehicle is positioned on the launch pad, the removable curb would be replaced and sealed with

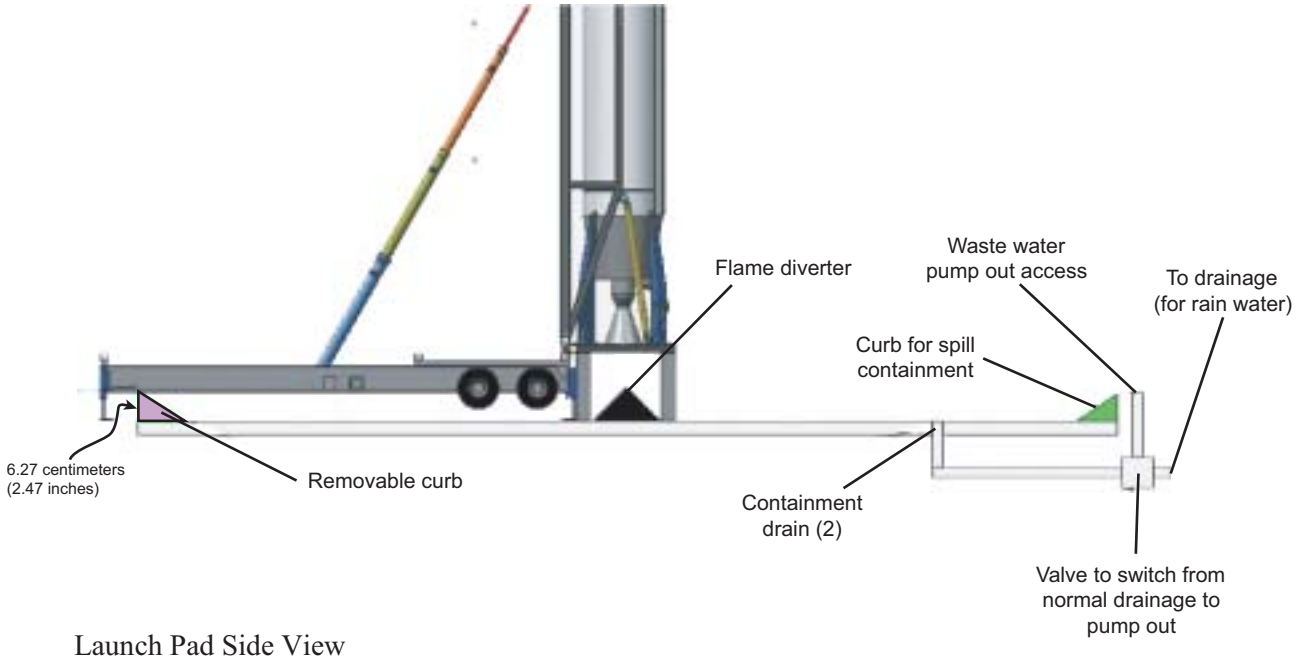
EXPLANATION

J.A. Jones Building

Figure 2-2



Omelek Launch Pad, Top View



Launch Pad Side View

EXPLANATION

Proposed Omelek Launch Pad

Figure 2-3

a rubber seal that is either a part of the curb or put in after the curb is in place. Malleable rubber curbs are commonly used to contain fluids and spills. The berm would be of sufficient height to contain up to approximately 7,570 liters (2,000 gallons) of deluge water spray used during launch. A valved drainage system would be included in the pad to allow rainwater drainage when the pad is not in use.

A 2,270-liter (600-gallon) freshwater tank would be available on-island that is refilled or swapped out on a weekly or biweekly basis by one of the landing craft. Freshwater would be used for pad cleanup and firefighting. The water for the deluge system would be supplied from the ocean. A land-based pump would be connected to an attended intake hose that would be floated into the lagoon and suspended just under the water. Lines to the spray system on the launch pad would be placed temporarily on the ground for each launch. The pump would require its own integral 3- to 7.5-kilowatt generator. Spray nozzles on the launch stand would direct deluge water to structures such as the flame diverter and the concrete. The deluge spray would be used to keep surfaces relatively cool, at least below their respective melting points. The deluge rate would be approximately 3,785 liters (1,000 gallons) in 30 seconds.

Approximately 35 to 50 percent of the deluge water would be reduced to steam. After each proof-of-principle flight test, the deluge water remaining on the launch pad as well as water used to clean the launch pad before and after launches would be placed in a temporary evaporative pond and tested. If contaminants are found, the wastewater would be containerized and disposed of according to UES requirements. If no contaminants are found, the water would be allowed to remain in the pond and evaporate. The evaporative pond would be constructed of sandbags and a membrane lining and would be capable of holding up to 9,464 liters (2,500 gallons) of water. The pond would be approximately 5.6 meters by 5.6 meters by 0.3 meter (18.5 feet by 18.5 feet by 1 foot) and would be temporarily placed in an area approximately 30.5 meters (100 feet) from the launch pad. Measures would be taken (e.g., a tent or elevated tarp cover over the pond) that would allow evaporation but also prevent access by birds that could be attracted to the standing water.

A new walkway from the pier to the island would be built. Some emergency lighting would be provided around the dock area to facilitate an evacuation at night. A new diesel fuel storage tank to supply the generators would be added to the existing diesel storage area, which includes a containment area. Although a concrete pad would be poured to support a LOX plant and storage tanks, LOX and liquid nitrogen may be brought in from the United States for the missions.

Launch Preparation Activities

Most SpaceX equipment including the launch vehicle would arrive at USAKA via commercial cargo carrier and would be transferred to Omelek using a landing craft. SpaceX equipment and the launch vehicle may or may not be stored on Kwajalein Island before movement to Omelek. The delivery to Omelek would be delayed until enough equipment arrives to fill the landing craft. Therefore, the equipment and launch vehicle system may need to be moved to storage while waiting for transport to Omelek. The launch vehicle would be stored in an existing physically secured area. The equipment containers could be stored in any unsecured location.

Once the landing craft arrives at Omelek, the equipment would be off-loaded and positioned in accordance with one of the layout options described in section 2.1.3. Either lumber or steel would be used if the ramp angle of the landing craft requires adjustment for offloading the missile and

erector. Approximately 30 people would be involved in launch preparation activities. Up to 10 SpaceX personnel would live on Omelek in the SpaceX office facility. The remaining personnel would be lodged on Kwajalein and transported between the two islands on a daily basis. All SpaceX and payload customer personnel would receive training in Omelek environmental issues. Actions would be taken to minimize disturbance, such as posting signs to designate sensitive areas on the northern part of the island, such as the biologically and archaeologically sensitive old broadleaf forest, and providing personnel with information on the need to respect and protect sensitive island resources and to avoid harassment of sensitive species. On the day of launch or the day before, SpaceX or USAKA/RTS personnel would fence the beach 100 meters (328 feet) on either side of the launch site just above the wave surge area (so the fence will remain in place) at a sufficient height to prevent sea turtles from hauling out at this area.

The Falcon launch vehicle would be moved to the launch pad on the transporter/erector, as shown in figure 2-4. The transporter/erector would be approximately 2.67 meters (8.75 feet) wide, 21 meters (70 feet) long, and 4 meters (13 feet) tall. During erection operations, the outriggers mounted on the trailer would be extended and lowered to the ground to raise the weight off the vehicle axles. The outriggers would be lowered hydraulically but locked mechanically to prevent backing off of the jacks. The forward end of the trailer would be chained to the concrete launch pad in two places to prevent the possibility of over-extension. After erection of the launch vehicle, four guy wires would be installed and tensioned to stabilize the erected structure and provide additional safety against surface wind loads. Once fueling operations for the launch vehicle begin, the drainage system valve would remain closed to avoid the possibility of any contaminants reaching the surrounding soil.

If LOX and liquid nitrogen are not brought in from the United States, production at the LOX plant would begin once personnel arrive on Omelek. The LOX plant would also produce liquid nitrogen, which would chill down the LOX loading and handling equipment as well as the LOX systems on board the Falcon vehicle. LOX and liquid nitrogen would only be produced during launch preparation activities for each launch. The LOX plant would not be operated between missions. Lines would be laid over the ground from the LOX plant to the launch pad area for fueling.

Helium would be used by the Falcon vehicle system as a pressurant for the main tanks during flight. Helium would also be used as a purge during fueling operations and at engine start. The helium would be stored in a standard, over-the-road supply trailer. The trailer would be Department of Transportation certified and would have pumping equipment attached.

The trailer-mounted kerosene storage trailer would be located in a cleared area, and no concrete pad would be required. The storage trailer would be place in an open area approximately 30.5 meters (100 feet) from the launch vehicle and 30.5 meters (100 feet) from the LOX plant. Lines would be run between the loading equipment and the launch pad over the ground for fueling. Portable containment would be provided as an extra precaution against spills. Any spills would be contained and cleaned up per the procedures identified in the Kwajalein Environmental Emergency Plan.

Payload preparation activities would be conducted in parallel with most launch vehicle preparation activities. Two dress rehearsals would be included in the launch preparation schedule to allow for team training and coordination of activities between the SpaceX crew and USAKA/RTS. The launch vehicle would be erected approximately 4 days before launch, and this would be the first opportunity to test transmissions from the launch vehicle and reception at USAKA/RTS stations.

EXPLANATION

Falcon Transporter/Erector

Not to Scale

Figure 2-4

The kerosene and the helium would be loaded into the Falcon launch vehicle on the day before launch. The thrust vector control would also be checked at this time.

Launch Activities

Day of Launch

The Falcon launch countdown is a 6-hour procedure that would be submitted for USAKA/RTS review and approval before implementation. On the day of launch, the back-out crew would perform the following activities during the 4 hours prior to launch:

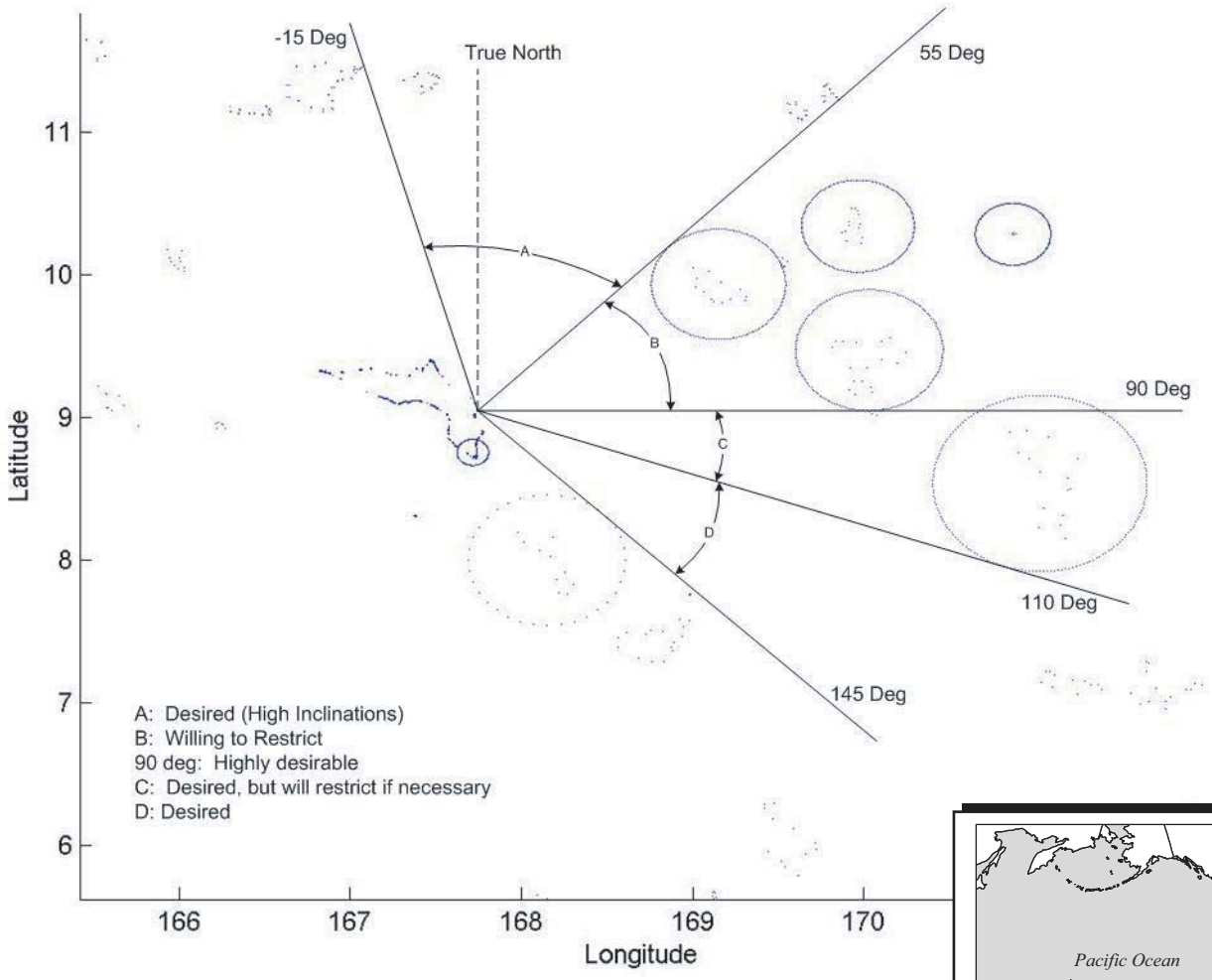
- Final launch pad preparations completed, including removal of all loose items, such as tarpaulins and tool boxes
- Erector lowered and removed from the immediate area of the launch pad
- All ground support equipment is configured for remote operation
- Fire fighting equipment is prepared
- Final volume of helium loaded
- LOX loaded
- Final inspections of the island and the pad area are performed (environmental monitor(s) would walk around the island to determine the presence/absence of species of concern prior to evacuation of the island)
- Island evacuated

The deluge system would begin approximately 10 seconds before launch and would continue until 30 seconds after launch. The water remaining after launch would be contained within the berm area of the launch pad. The Falcon launch vehicle would have a burn zone of approximately 15 meters (50 feet).

Launch Trajectory

The proposed launch site can accommodate safe trajectories for almost any orbital inclination. Figure 2-5 shows desired launch azimuths. The first Falcon mission from Omelek would be a sun-synchronous orbit (satellite passes over the same part of the earth at about the same local sun time each day) at an 800-kilometer (497-mile) altitude with a launch azimuth of –3 degrees (true). The second mission would be for a 90-degree azimuth to an orbit of 685 kilometers (425 miles). These two trajectories represent the most common azimuths expected to be used from USAKA/RTS. Some limited maneuvering would be possible if necessary to avoid sensitive areas.

The Falcon flight vehicle is designed to allow the spent first stage to be recovered by the use of a parachute attached to the front end of the first stage at a location as indicated in tables 2-1 and 2-2. A salvage ship would locate the floating first stage by homing in on a transponder that signals the location. There is a potential for approximately 30.3 liters (8 gallons) of LOX and 19 liters (5 gallons) of kerosene to remain in the expended first stage. The first stage would be recovered by USAKA/RTS personnel and equipment and returned to Kwajalein. SpaceX would then transport it to their facilities in El Segundo, California, for reconditioning and reuse.



INDEX MAP

EXPLANATION

◯ Protection circles for inhabited islands

Potential Launch Azimuths From Omelek

Kwajalein Atoll, Pacific Ocean

Not to Scale

Figure 2-5

Table 2-1: Impact Locations for First Stage and Fairing (–3 Degrees)

	Latitude	Longitude	Impact Ellipse Estimate
First Stage	18.003 degrees	167.043 degrees	64 kilometers x 32 kilometers (40 miles x 20 miles)
Fairing	18.782 degrees	166.694 degrees	80 kilometers x 64 kilometers (50 miles x 40 miles)

Table 2-2: Impact Locations for First Stage and Fairing (90 Degrees)

	Latitude	Longitude	Impact Ellipse Estimate
First Stage	8.9155 degrees	176.814 degrees	64 kilometers x 32 kilometers (40 miles x 20 miles)
Fairing	8.899 degrees	177.589 degrees	80 kilometers x 64 kilometers (50 miles x 40 miles)

The payload fairing would drop at a location downrange into the Pacific Ocean, as indicated in tables 2-1 and 2-2. The second stage would go into a degrading orbit with the payload. It will eventually reenter the atmosphere, but will burn up upon reentry and it is highly unlikely that any debris would reach the earth.

Post-Launch Activities

The back-out crew that accomplishes all the on-Omelek tasks in the 4 hours or so prior to launch would be located at Meck for both mission abort operations and post-flight operations. This crew would arrive and depart Meck by boat and would be in communication with the launch organization at Meck. After launch and approval by ground safety, the crew would approach Omelek and begin post-launch procedures.

SpaceX back-out personnel would clean up the launch site. Fresh water brought to the island by SpaceX personnel would be used to douse fires if necessary and for initial cleanup on the pad. The back-out crew would bring fire pumps and standard extinguishers to Omelek. Fresh water would also be used to rinse the pad and launch stand before securing for storage. A 2,270-liter (600-gallon) water tank would be available on-island that is refilled or swapped out on a weekly or biweekly basis by one of the landing craft. After each proof-of-principle flight test, the deluge water remaining on the launch pad as well as water used to clean the launch pad before and after launches would be placed in a temporary evaporative pond and tested. If contaminants are found, the wastewater would be containerized and disposed of according to UES requirements. If no contaminants are found, the water would be allowed to remain in the pond and evaporate. The residual salt would be disposed of in the Kwajalein landfill. After the wastewater is removed, the drainage system valve would be left in the open position to allow rainwater to drain from the launch pad.

SpaceX back-out personnel would remove all hazardous and non-hazardous waste from Omelek and dispose of it in accordance with USAKA/RTS regulations and the UES. All equipment except for the LOX plant, diesel storage container, SpaceX office facility, and the water storage containers would be removed after the launch operation. Kerosene and the helium storage trailer would be removed from the island after completion of the mission. The LOX and liquid nitrogen would be allowed to boil off and the plant would be secured. Facilities at Omelek would be cleaned and prepared for storage within approximately 7 days. Environmental monitors would walk around the island to see if there were any observable effects of the launch to sensitive species. Any observable effects would be reported to applicable agencies through USAKA/RTS as required.

2.1.3 OPTIONS FOR LOCATIONS OF FACILITIES

There are four options for the locations of the facilities to be used at Omelek. They are described below.

Option 1

Option 1 (figure 2-6) involves the construction of a new launch pad, the LOX plant, and fuel storage facilities on the east side of the island. The LOX plant would be built more than 24 meters (80 feet) from the center of the launch pad. The new MAB would be sited on the southwest quadrant of the island along with the J.A. Jones building. The launch control van would be placed on the west side of the island.

Option 2

In Option 2 (figure 2-7) the launch pad and a new 4.3- by 30.5-meter (14- by 100-foot) slab to facilitate connecting the erector to the launcher would be constructed on the northern part of the island. The LOX plant would be built west of the slab more than 24 meters (80 feet) from the center of the launch pad. The fuel storage facility would be built on the east side of the slab. A new road would be required. The MAB and the J.A. Jones building would all be placed in the southwest quadrant of the island, as in Option 1. The launch control van would be placed between the MAB and the J.A. Jones building.

Option 3

In Option 3 (figure 2-8) the launch pad and slab, the LOX plant, and the fuel storage facility would be built in the same sites as described in Option 2. The MAB would be built on the east side of the island. The J.A. Jones building would be placed in the southeast quadrant of the island. The launch control van would be placed in the southwest quadrant of the island in the same location used in Option 2.

Option 4

In Option 4 (figure 2-9) the location of the launch pad, the LOX plant, and the fuel storage facility would be the same as described in Option 1. The MAB would also be at the same site used for Option 1. The J.A. Jones building and the launch control van would be placed on the west side of the island. Option 4 is the Preferred Alternative.

EXPLANATION

Option 1

Scale

NORTH

0 34.7 69.4 meters

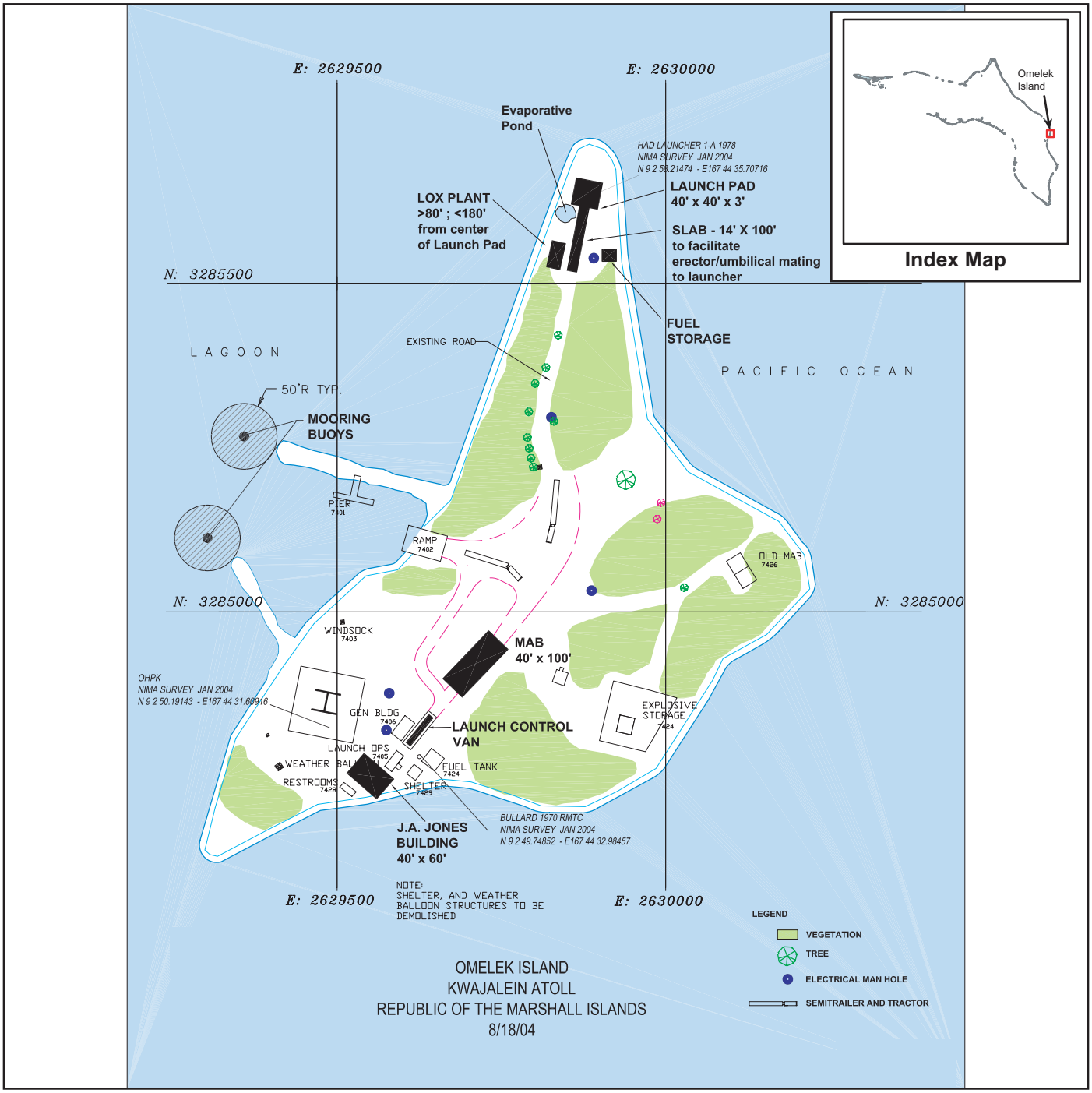
0 113.8 227.7 feet

10-12-04 Option 1

Omelek, Kwajalein Atoll

Figure 2-6

Proof-of-Principle Space Launches from Omelek Island EA



EXPLANATION

Option 2

Scale

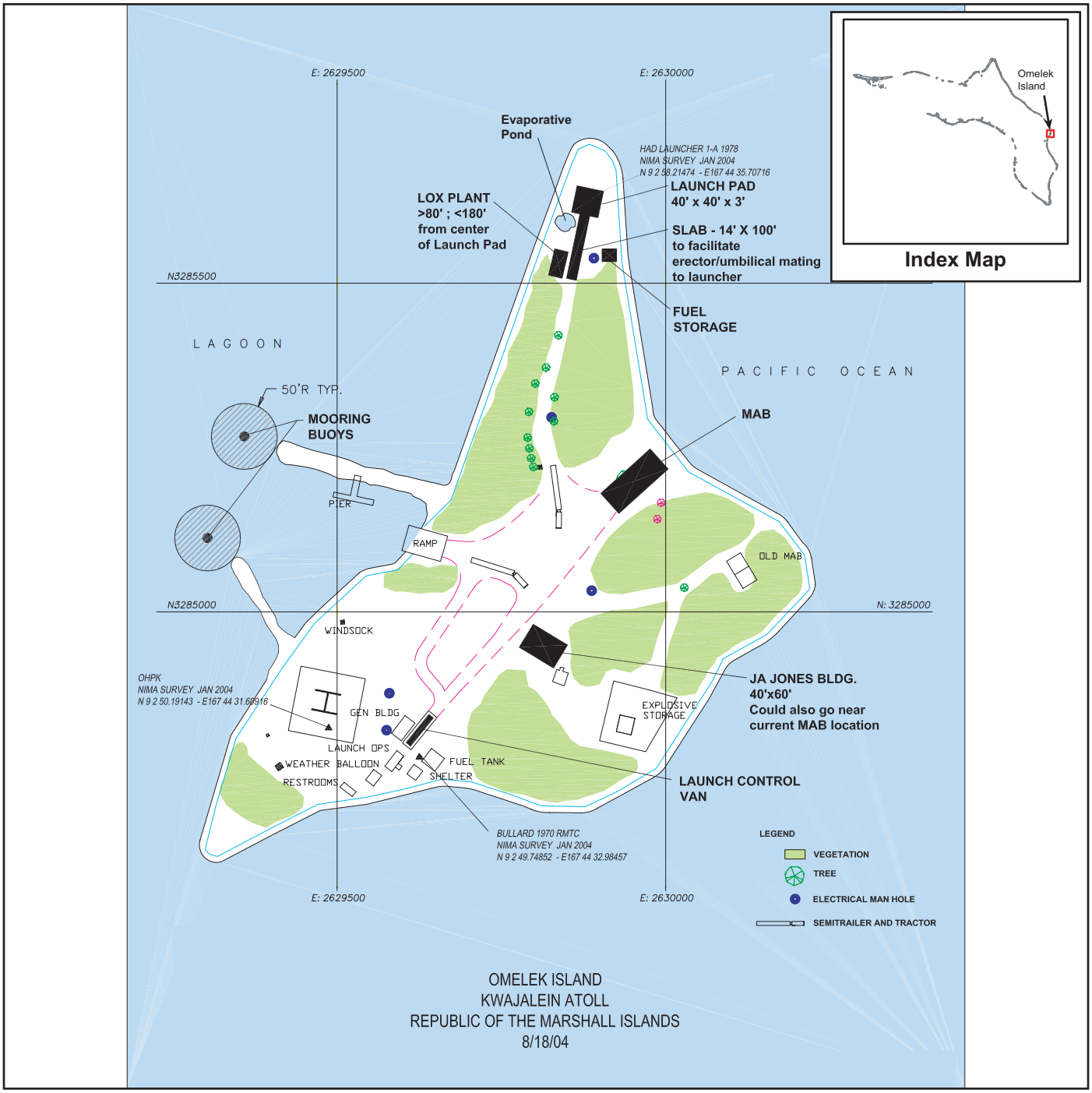
0 34.7 69.4 meters

NORTH 0 113.8 227.7 feet

Omelek, Kwajalein Atoll

Figure 2-7

10-12-04 Option 2



EXPLANATION

Option 3

Scale

0 34.7 69.4 meters

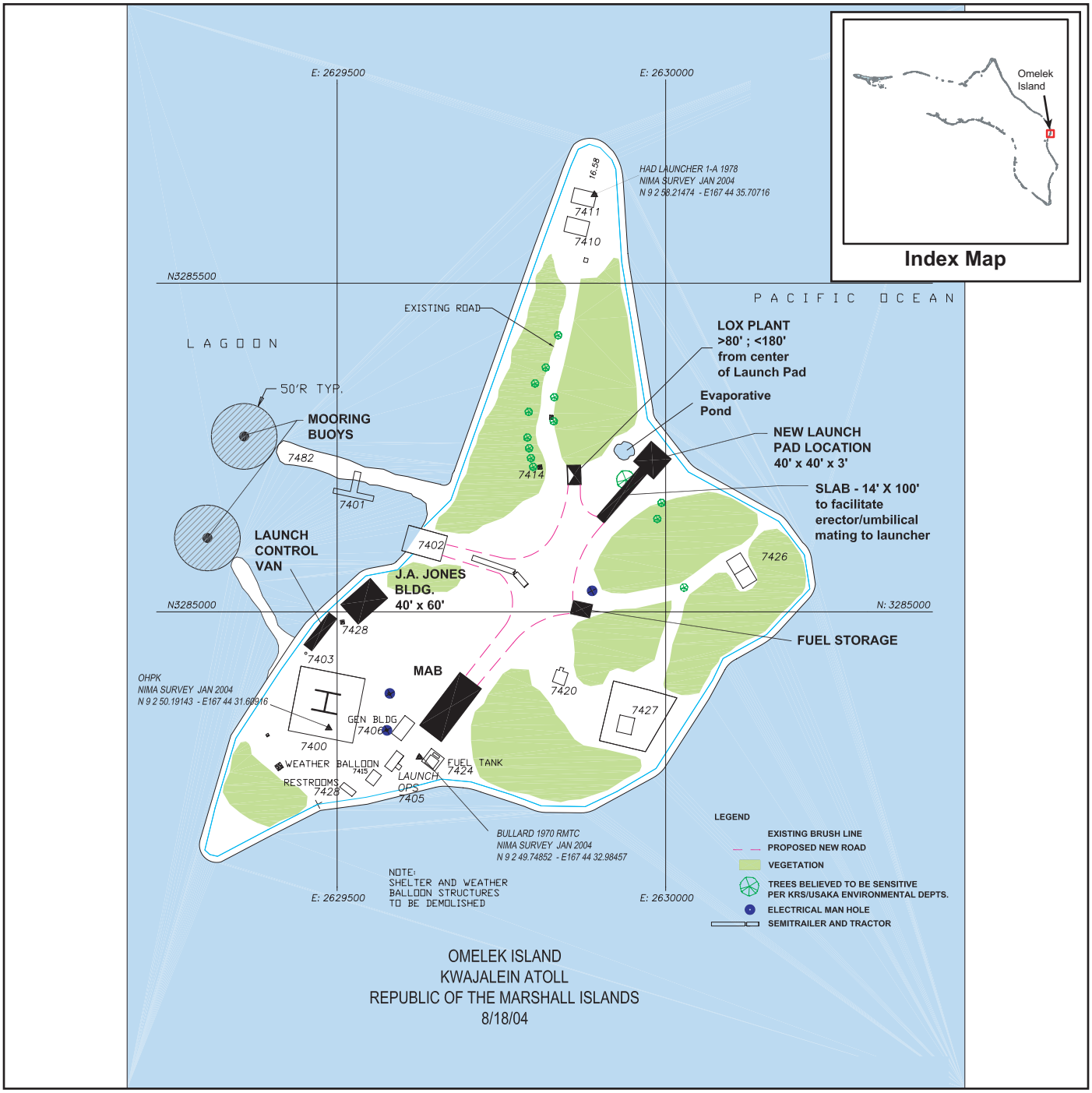
NORTH 0 113.8 227.7 feet

10-12-04 Option 3

Omelek, Kwajalein Atoll

Figure 2-8

Proof-of-Principle Space Launches from Omelek Island EA



EXPLANATION

Option 4

NORTH

Scale

0 34.7 69.4 meters

0 113.8 227.7 feet

10-12-04 Option 4

Omelek, Kwajalein Atoll

Figure 2-9

2.2 NO-ACTION ALTERNATIVE

Under the No-action Alternative, the proposed Falcon launch vehicle activities would not be conducted at Omelek and SpaceX would not proceed with the modifications to the facilities on Omelek. SpaceX would not be able to demonstrate the capability/establish the infrastructure at Omelek to launch satellite payloads into orbit from USAKA/RTS.

2.3 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

Two categories of alternatives were considered during the preparation of this EA. The first was the siting of the location of facilities and the second was the siting of the entire launch complex.

An additional siting option suggested involved locating the launch pad well away from the main area of native forest and restricting the "footprint" of the project to a smaller total area in the southern part of the island. This option would include the use of existing building sites and removal of decrepit structures from the island as necessary rather than creating new building sites, even if some of the new buildings would be removed at the conclusion of the project. The MAB, for example, could be placed near the helipad, and the gray wood-frame and corrugated metal building currently near the helipad could be removed. The launch pad could be placed on or near the site of Building 7428 (the abandoned restrooms).

This alternative siting option and several variations were examined for utility and were found not to be usable for several reasons. First, if the launch pad were placed on or near Building 7428, this would place the existing helipad too close to the launch pad and a catastrophic event could damage the helipad and render it unusable. This could limit the access to the island. Secondly, placing the launch pad at this site, which is in the middle of the leach field for the septic system, would necessitate digging a new leach field in another area. Also having the launch pad on this end of the island endangers much of the infrastructure on the island, which would have to be moved away from the launch area, necessitating additional disturbance to the island. The requirements of the Falcon Launch Vehicle Program include collocation of the LOX plant and the fuel storage in close proximity to the launch pad. A requirement also exists for the new MAB to be in a straight line alignment with the new launch pad. The need under this alternative option to then realign the existing road to the old MAB would actually result in the removal of a great deal more vegetation than the preferred alternative (Option 4) or even Option 1. This alternative option would not be more environmentally desirable than the preferred alternative (Option 4). This alternative siting option was therefore not carried forward for further consideration.

The use of an equatorial site is essential for very low inclination launches. The geographical sites described below were considered and dismissed from further consideration as alternatives to USAKA/RTS.

Cape Canaveral, Florida

SpaceX would use Launch Complex 46 for medium inclination launches. However, use of Cape Canaveral for low inclination launches would require overflight of populated areas. Therefore, Cape Canaveral was dismissed from further consideration for low inclination launches.

Alcantara Launch Facility, Brazil

The Alcantara Launch Center is on the Atlantic coast outside of Sao Luis, Brazil. Launch pads on the ground blast off Satellite Launch Vehicle or Veiculo Lancador de Satelites space boosters, Sonda sounding rockets, meteorological rockets and other science boosters. Brazilian scientists have launched hundreds of sounding rockets since the mid-1960s. Alcantara, also known as CLA, has a launch control center and blockhouse. Its position nearer the equator is said to offer a launch advantage over Cape Canaveral. However, an accident in August 2003 destroyed some of the launch facilities. (Space Today Online, 2003) Therefore, the Alcantara Launch Facility was not carried forward for further consideration.

Guiana Space Center, Kouru, French Guiana

The Guiana Space Center is the launch site for the European Ariane vehicles. The Guiana Space Center—also known as the Spaceport—is a strategically located facility that provides the optimum operating conditions for Arianespace's commercial launches. Situated close to the equator at 5.3 degrees North latitude, the Spaceport is ideally situated for missions into geostationary orbit. Launching near the equator reduces the energy required for orbit plane change maneuvers. This saves fuel, enabling an increased operational lifetime for Ariane satellite payloads—and, in turn, an improved return on investment for the spacecraft operators. The French Guiana coastline's shape allows for launches into all useful orbits from northward launches to –10.5 degrees, through eastward missions to +93.5 degrees. (Arianespace, 2004) However, operations would be prohibitively expensive due to State Department International Traffic in Arms Regulations. Therefore, the Guiana Space Center was dismissed from further consideration as an alternative launch location.

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3.0
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

This section describes the environmental characteristics that may be affected by the Proposed Action at USAKA/RTS. To provide a baseline point of reference for understanding any potential impacts, the affected environment is concisely described; any components of concern are described in greater detail. The EA evaluates the potential environmental impacts of construction and operation of a new launch pad and new MAB, refurbishment of existing facilities, and the addition of two new mooring buoys at Omelek. The EA also evaluates related activities, such as safety issues associated with transporting, handling, and storage of Falcon missile components, which could have potential impacts on public health and safety or the environment.

Available reference materials, including EAs, environmental impact statements (EISs), and natural resources plans, were reviewed. Questions were directed to installation and facility personnel and private individuals. Site visits were also conducted where necessary to gather the baseline data presented below.

Environmental Resources

Thirteen broad areas of environmental consideration were originally considered to provide a context for understanding the potential effects of the Proposed Action and to provide a basis for assessing the severity of potential impacts. These areas included air quality, airspace, biological resources, cultural resources, environmental justice, geology and soils, hazardous materials and waste, health and safety, infrastructure, land use, noise, socioeconomics, and water resources. These areas were analyzed as applicable for the proposed location or activity.

Based on an initial analysis, it was determined that the activities proposed would not result in impacts to land use of USAKA/RTS. Omelek would remain under U.S. Army management and would continue to be used for missile research. The Proposed Action is consistent with the mission of the island and would not conflict with any known land use plans, policies, or controls.

The back-out crew located on Meck for both mission abort and post-flight operations would use existing facilities with no potential for environmental impacts. Temporary storage of the Falcon system components on Kwajalein would also be accomplished using facilities that currently handle similar items. Resources with a potential for impacts from this temporary storage would be hazardous materials and waste and health and safety.

Only a few existing base personnel would be involved, and only 20 SpaceX personnel would require lodging on Kwajalein; thus, there would be no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts would not occur to any minority or low-income populations under Executive Order 12898 (Environmental Justice) or environmental health and safety risks that may disproportionately affect children under Executive Order 13045 (Federal Actions to Address Protection of Children from Environmental Health and Safety Risks).

For purposes of this analysis, open ocean refers to those ocean areas beyond U.S. and RMI territorial limits. Open ocean areas are subject to Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. A limited number of resources could potentially be

affected in open ocean areas by the Proposed Action including airspace, biological resources, and health and safety. Noise and water impacts are relevant only with respect to effects on biological resources.

Environmental Setting

Kwajalein Atoll is located in the western chain of the RMI in the West Central Pacific Ocean. USAKA/RTS leases all or part of 11 islands in the Atoll, including Omelek. Omelek is a 3.2-hectare (8-acre) island located about halfway between Kwajalein and Roi-Namur islands. Launch activities have not been conducted on Omelek since 1996.

3.1 U.S. ARMY KWAJALEIN ATOLL, OMELEK ISLAND

3.1.1 AIR QUALITY

Air quality in a given location is described by the concentrations of various pollutants in the atmosphere, expressed in units of parts per million, or micrograms per cubic meter ($\mu g/m^3$). Pollutant concentrations are determined by the type and amount of pollutants emitted into the atmosphere; the physical characteristics, including size and topography; and meteorological conditions related to prevailing climate.

The significance of a pollutant concentration is determined by its comparison with ambient air quality standards set in the *Environmental Standards and Procedures for U.S. Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands* (U.S. Army Space and Missile Defense Command, 2003). Table 3-1 lists these standards, which reflect 80 percent of the National Ambient Air Quality Standards established by the U.S. Environmental Protection Agency. Table 3-2 lists threshold limits for the same pollutants from new stationary sources at USAKA. In the event that these levels are exceeded, a document of environmental protection would be required for the new stationary source.

Region of Influence

The region of influence (ROI) for ozone may extend much further downwind than the ROI for inert pollutants; however, as the project area has no heavy industry and very few automobiles, tropospheric ozone and its precursors are not of concern. For the air quality analysis, the ROI for project operational activities includes Omelek.

Affected Environment

Climate

While available climatological information is specific to the island of Kwajalein, the other USAKA islands, including Omelek, have very similar climates. The average monthly temperatures on Kwajalein range from 27 to 29 degrees Celsius (80 to 85 degrees Fahrenheit), depending on the season. The average annual precipitation is 256 centimeters (101 inches), 75 percent of which is recorded from mid-May to mid-December (the rainy season). During this time, light, easterly winds and frequent moderate to heavy showers prevail. During the drier season, light showers of short duration occur, and cloud cover is at a minimum. The relative humidity is uniformly high throughout the year, with values almost always between 70 and 85 percent. (U.S. Army Space and Strategic Defense Command, 1995)

Table 3-1: USAKA Ambient Air Quality Standards

Pollutant	Averaging Time	Standard
Carbon Monoxide	8-hour	8 mg/m^3 (7.2 ppm)
	1-hour	32 mg/m^3 (28 ppm)
Nitrogen Dioxide	Annual (1)	80 $\mu g/m^3$ (0.0424 ppm)
Ozone	8-hour (2)	128 $\mu g/m^3$ (0.064 ppm) (1)
Sulfur Oxides	Annual (1)	64 $\mu g/m^3$ (0.024 ppm)
	24-hour	292 $\mu g/m^3$ (0.112 ppm)
	3-hour	1,040 $\mu g/m^3$ (0.4 ppm)
Lead	Quarterly (1)	1.2 $\mu g/m^3$
PM-2.5	Annual (3)	12 $\mu g/m^3$
	24-hour (4)	52 $\mu g/m^3$
PM-10	Annual (arithmetic mean)	40 $\mu g/m^3$
	24-hour (5)	120 $\mu g/m^3$

Source: U.S. Army Space and Missile Defense Command, 2003
(1) Calculated as the arithmetic mean
(2) Calculated as the 3-year average of the fourth highest daily maximum 8-hour ozone concentration
(3) Calculated as the 3-year average of the arithmetic means
(4) Calculated as the 98th percentile of 24-hour PM-2.5 concentration in a year (averaged over 3 years) at the population-oriented monitoring site with the highest measured values in the area
(5) Calculated as the 99th percentile of 24-hour PM-10 concentrations in a year (averaged over 3 years)

$\mu g/m^3$ = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter
PM-2.5 = fine particulate matter equal to or less than 2.5 microns in size
PM-10 = particulate matter equal to or less than 10 microns in size (also called respirable particulate and suspended particulate)
ppm = parts per million

Table 3-2: USAKA Pollutant Thresholds

Pollutant	Threshold
Carbon monoxide	90.7 metric tons (100 tons) per year
Nitrogen oxides	36.3 metric tons (40 tons) per year
Sulfur dioxide	36.3 metric tons (40 tons) per year
Ozone	36.3 metric tons (40 tons) per year of volatile organic compounds
Particulate matter	22.7 metric tons (25 tons) per year of PM emissions 13.6 metric tons (15 tons) per year of PM-10 emissions

Source: U.S. Army Space and Missile Defense Command, 2003

Trade winds are strongest from December to June. The prevailing winds blow from the east to northeast with an average speed of 26 kilometers (16 miles) per hour in the winter and 10 kilometers (9 miles) per hour in the summer. (U.S. Army Kwajalein Atoll/Kwajalein Missile Range, 1999; U.S. Army Space and Strategic Defense Command, 1995)

Regional Air Quality

No ambient air quality data are known to exist for Omelek. However, since there are only extremely minor sources of air pollution such as occasional helicopter landings, strong persistent trade winds, and lack of topographic features to inhibit dispersion, the ambient air quality at Omelek is expected to be in compliance with the maximum pollution levels established in the UES.

Existing Emission Sources

Existing primary pollution sources at USAKA/RTS include power plants, fuel storage tanks, solid waste incinerators, and transportation. Rocket launches are generally a smaller source of emissions. Omelek facilities have been abandoned and are no longer in use; therefore, no existing emission sources are currently located at Omelek.

3.1.2 AIRSPACE

Airspace, while generally viewed as being unlimited, is finite in nature. It can be defined dimensionally by height, depth, width, and period of use (time). The Federal Aviation Administration (FAA) is charged with the overall management of airspace and has established criteria and limits for use of various sections of this airspace in accordance with procedures of the International Civil Aviation Organization (ICAO).

Region of Influence

The ROI for airspace at USAKA/RTS includes the airspace over and surrounding the proposed launch site on Omelek, the launch hazard area, and debris containment corridor as well as potential regional radiation hazard areas.

Affected Environment

Controlled and Uncontrolled Airspace

USAKA/RTS is located in international airspace. Therefore, the procedures of the ICAO outlined in ICAO Document 4444, *Rules of the Air and Air Traffic Services*, are followed (International Civil Aviation Organization, 1996; 1997). ICAO Document 4444 is the equivalent air traffic control manual to the FAA Handbook 7110.65, *Air Traffic Control*. The ICAO is not an active air traffic control agency and has no authority to allow aircraft into a particular sovereign nation's Flight Information Region or Air Defense Identification Zone and does not set international boundaries for air traffic control purposes. The ICAO is a specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transportation.

The FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in the ROI is managed by the Oakland Air Route Traffic Control Center (ARTCC) in its Oceanic Control-6 Sector, the boundaries of which are shown in figure 3-1.

EXPLANATION

FIR = Flight Information Region

OC = Oceanic Control Sectors within the Oakland FIR

Oakland FIR Boundary

Sector Boundaries

Radar Control Areas

Airspace Managed by the Oakland Oceanic Control Area Administrative Boundaries

Pacific Ocean

Not to Scale

NORTH

Figure 3-1

10-12-04 Oakland Airspace

Special Use Airspace

There is no special use airspace in the ROI.

En Route Airways and Jet Routes

Although relatively remote from the majority of jet routes that cross the Pacific, USAKA/RTS and vicinity have two jet routes above Kwajalein, R-584 and A-222 (figure 3-2). An accounting of the number of flights using each jet route is not maintained.

Although not depicted on either the North Pacific Route Chart Southwest Area or Composite, there are low altitude, propeller driven aircraft carrying commercial traffic between the various islands of the RMI, particularly between the Marshall Islands International Airport at Majuro and Bucholz Army Airfield on Kwajalein.

Airports/Airfields

Bucholz Army Airfield has had a reported a maximum of 1,674 operations per month, an average of over 55 per day. Many of the 55 flights per day were aircraft and helicopter flights to other USAKA islands. Currently flight activity through Bucholz Army Airfield is about 25 flights per day (Sims, 2004c). Dyess Army Airfield on Roi-Namur provides service to a variety of aircraft and helicopters.

3.1.3 BIOLOGICAL RESOURCES

Native or naturalized vegetation, wildlife, and the habitats in which they occur are collectively referred to as biological resources. For the purpose of discussion, biological resources have been divided into the areas of vegetation, wildlife, threatened and endangered species, and environmentally sensitive habitat.

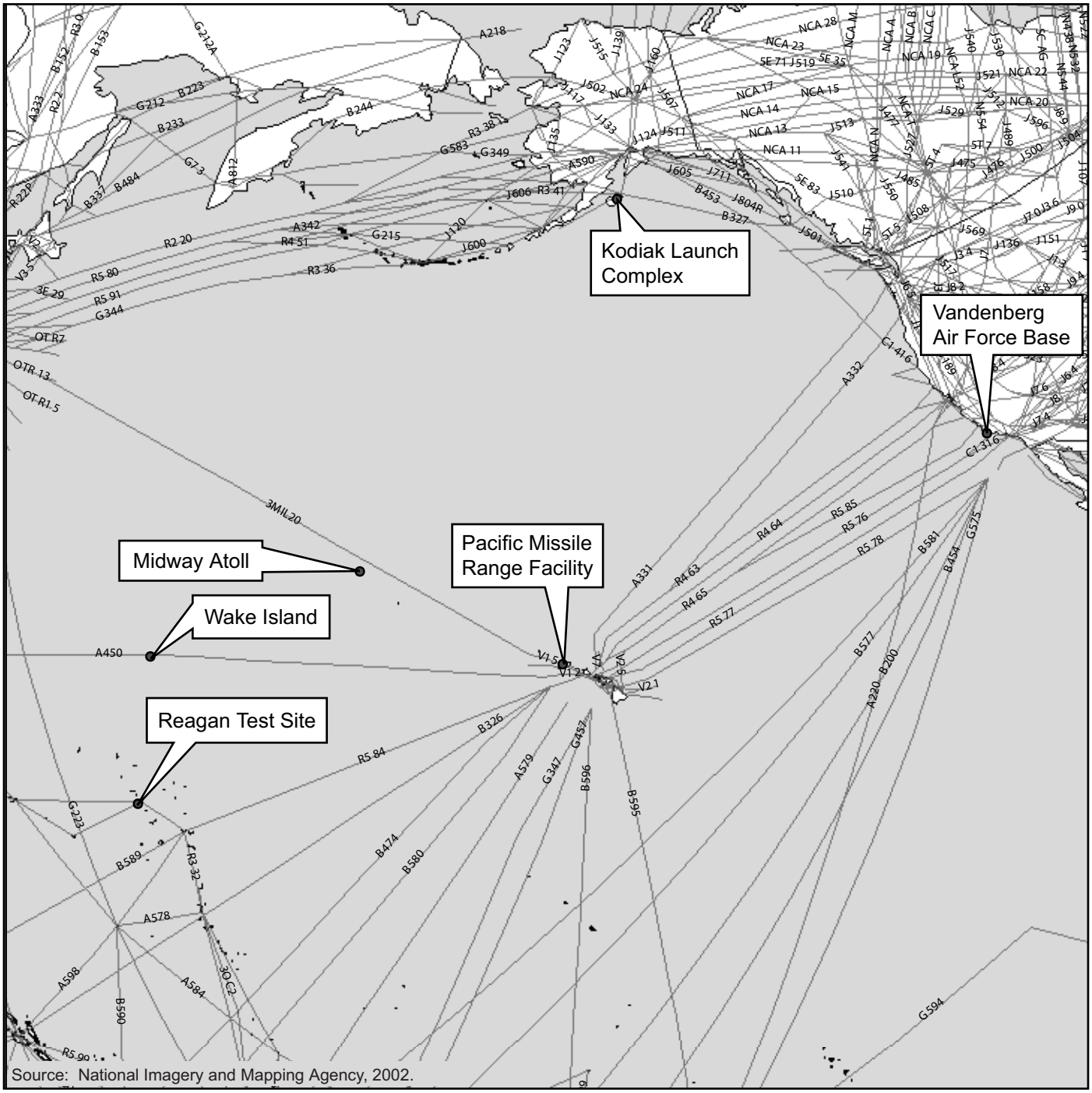
Region of Influence

The ROI for biology includes Omelek and the surrounding waters that may be affected by the proposed activities. Figure 3-3 shows the biological resources of Omelek and the surrounding reef flat.

Affected Environment

Vegetation

From a general point of view, there is only one type of native forest in the Marshall Islands, the mixed broadleaf forest. Approximately two-thirds of Omelek has been cleared and this area is dominated by nonnative grasses and weeds. The remaining habitat contains three separate patches of mixed broadleaf forest: eastern patch, northern patch, and southern patch. The relatively open interior of the island is mostly free of woody plants and is overgrown in areas with a tall (greater than 3 feet) mat dominated by beach pea and beggar's tick (U.S. Department of the Army Space and Missile Defense Command, 2004). Native *Scaevola sericea* shrubs, also known as saltbush, are slowly invading areas of Omelek (Sims, 2004b). *Pisonia grandis*, a stocky tree common to the Marshall Islands, can be found on Omelek, as well. (See appendix C.)



EXPLANATION

High Altitude Jet Routes

High Altitude Jet Routes

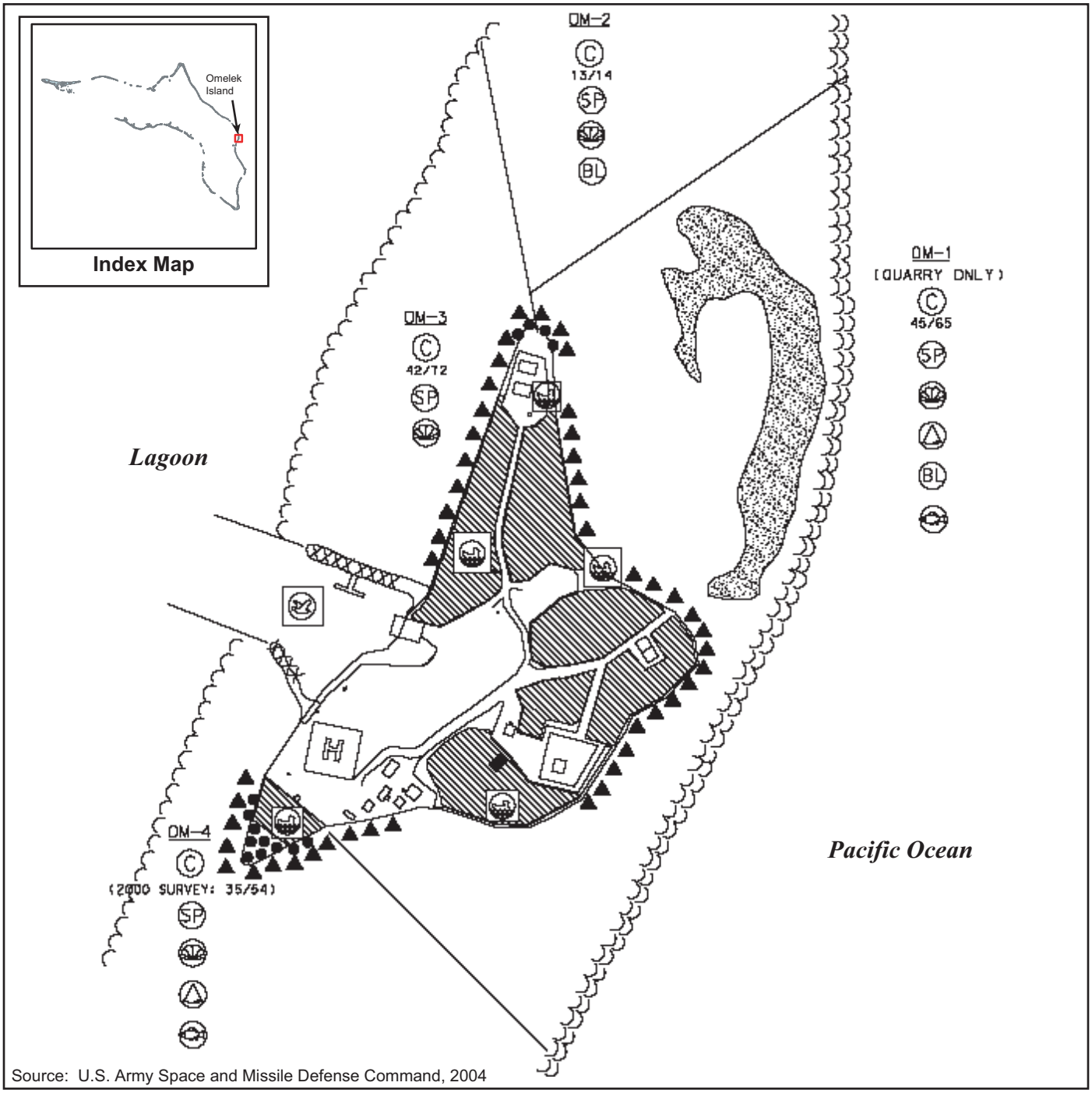
Pacific Ocean

Scale
0 635 1270 kilometers
0 394.5 789 miles

NORTH

Figure 3-2

10-12-04 High Alt Airways



EXPLANATION

- Marine survey sectors
- Coral (C x/y) — x- # of species of concern; y- Total # of coral species
- Sponge (SP)
- Giant Clams
- Trochus
- Black-Lip Pearl Oyster (BL)
- Reef Fish
- Seabirds / Shorebirds
- Seabirds foraging
- Helopad / Ephemeral pond (H)
- Shoreline habitat
- Turtle nesting and haulout
- Algal ridge
- Reef edge
- Littoral forest
- Quarry site
- Dock rip-rap (XXXX)

Scale

NORTH

0 43 86 meters

0 142 283 feet

10-12-04 Bio Omelek

Biological Resources of Omelek Island

Omelek, Kwajalein Atoll

Figure 3-3

Wildlife

The native forest patches on Omelek provide nesting, roosting, and resting habitat for a variety of seabirds (figure 3-3); *Pisonia* in particular is typically a favored nesting or rookery tree for sea birds, including the black noddy (United Nations University, 1993). Black and brown noddies and white terns are arboreal, although brown noddies may roost and nest on the ground. No nesting seabirds have been observed during the USAKA biological surveys. The island supported relatively little bird activity during the 2002 inventory. Black and brown noddies and black-naped terns have been observed foraging offshore. Black-naped terns have been observed occasionally at the north and south tips of the island where principal roosting habitat occurs. Open areas also provide habitat for black-naped terns. The reef heron, Pacific golden plover, gray-tailed and wandering tattlers, ruddy turnstone, and whimbrel have also been observed foraging on the island. A bristle-thighed curlew and one red-footed booby were observed in 2002. (U.S. Army Corps of Engineers, undated; U.S. Department of the Army Space and Missile Defense Command, 2002; 2004; U.S. Fish and Wildlife Service, 2004; appendix C)

Reptiles on the island include the azure-tailed skink and island gecko. Hermit and purple crabs are abundant on Omelek, and large red-brown land crabs have been found in the native forest. (U.S. Department of the Army Space and Missile Defense Command, 2004; appendix C.)

Recent surveys indicate the presence of big-headed and crazy ants and Formosan termites on Omelek, (U.S. Department of the Army Space and Missile Defense Command, 2002; 2004; U.S. Fish and Wildlife Service, 2004). Long-legged ants, an exotic species common on several nearby islands, were not observed on Omelek. (Sims, 2004a; U.S. Department of the Army Space and Missile Defense Command, 2002) Pink hibiscus mealy bugs have also been reported (see appendix C).

Giant clams, black-lipped pearl oyster, coral, sponges, and top shell snails are species of concern that have been observed in the vicinity of Omelek (U.S. Department of the Army Space and Missile Defense Command, 2002; 2004).

Threatened and Endangered Species

No threatened or endangered vegetation species have been identified on Kwajalein.

Sea turtles frequently enter the lagoon and are commonly seen in the harbors at Kwajalein, Roi-Namur, and in the waters surrounding Meck. Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles have been observed on and offshore of Kwajalein. (U.S. Army Space and Strategic Defense Command, 1995) Potential habitat for sea turtles on Omelek includes sandy beaches along the southern and northern tips of the island and the area of the lagoon shoreline from the northern tip of the island south to the north jetty (U.S. Army Corps of Engineers, undated; U.S. Department of the Army Space and Missile Defense Command, 2002).

Other threatened and endangered marine species that may possibly occur in and around USAKA/RTS include the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), hawksbill sea turtle, and olive ridley sea turtle

(*Lepidochelys olivacea*). Although whales are generally widely distributed, open water species, sperm whales and other whales are frequently sighted off Illeginni Island (Sims, 2004c).

Environmentally Sensitive Habitat

Marine and terrestrial habitats on Omelek that are considered of significant biological importance include: (marine) the lagoon area facing the reef slope and reef flat; the interisland reef flat; lagoon floor; ocean area facing the reef slope and reef flat; quarry pits; and intertidal zone, and (terrestrial) mixed broadleaf forest areas; seabird colonies; shorebird sites (U.S. Army Space and Missile Defense Command, 2003).

Although the harbor area has been dredged, the lagoon reef flat on either side of the jetties provides good quality marine habitat with thriving coral and giant clams (figure 3-3). The large quarried area on the ocean side also exhibits a diversity of marine life, including coral and giant clams. (U.S. Army Space and Strategic Defense Command, 1995)

An abundance of corals are in the area, but some areas show signs of stress while still others have areas of dead coral, particularly off the north point on the lagoon side (Sims, 2004b).

3.1.4 CULTURAL RESOURCES

According to the UES, cultural resources are material remains of human activity that are significant in the history, prehistory, architecture, or archaeology of the RMI. They include prehistoric resources and historic resources.

Region of Influence

The ROI for cultural resources includes areas on Omelek that would be disturbed by proposed activities.

Affected Environment

Prehistoric and Historic Archaeological Resources

Predictive modeling for the islands of the RMI shows that old broadleaf forest areas, especially on the western and northern parts of coral islands, are a marker for potential prehistoric sites. Additionally, the lack of surface artifacts should not be used as an indicator that subsurface remains are not present. Cultural materials have been found as deep as 169 centimeters (66.5 inches) below the surface at other coral island sites. Omelek has been heavily disturbed by prior construction and operational activities. Although most of the island has been graded and modified, there are three small remnants of mixed broadleaf forest. Archaeological surveys and tests seemed to indicate the potential presence of a traditional Marshallese cemetery, but no human remains were discovered. Since coral slabs, which have been found at the site, also occur naturally, the site more likely represents a naturally occurring phenomenon and therefore has not been recommended as potentially eligible for inclusion in the RMI National Register. (U.S. Army Space and Missile Defense Command, 2001)

Historic Buildings and Structures

No historic World War II or significant Cold War features have been identified on Omelek (U.S. Army Space and Missile Defense Command, 2001).

All of the buildings and structures on Omelek were constructed between 1962 and 1990; among them are meteorological rocket launch pads and associated facilities; although they are associated with the Cold War historic context, none have been evaluated for eligibility for inclusion in the RMI National Register. (U.S. Army Space and Missile Defense Command, 2004; U.S. Army Space and Strategic Defense Command, 1995)

Native Populations/Traditional Resources

Traditional resources can include archaeological sites, burial sites, ceremonial areas, caves, mountains, water sources, plant habitat or gathering areas, or any other natural area important to a culture for religious or heritage reasons. Significant traditional sites are subject to the same regulations, and afforded the same protection, as other types of historic properties. By their nature, traditional resources sites often overlap with (or are components of) archaeological sites. As such, some of the recorded and unrecorded sites identified within the ROI could also be considered traditional sites or contain traditional resources elements.

Traditional resources within the ROI are expected to be associated with the Marshallese culture, as such sites, some of which have been identified on Arno and Majuro atolls, are known to occur in the Marshall Islands. Omelek used to be a residence island, but was also frequented by the inhabitants of Meck for the purpose of natural resource exploitation. Land resources included coconut, pandanus, papaya, medicinal plants, and wood products; sea resources included fish and lobster. Omelek was also an extraordinary source of white paving pebbles.

Paleontological Resources

Paleontological resources consist of the physical remains of extinct life forms or species that may have living relatives. These physical remains include fossilized remains of plants and animals, casts or molds of the same, or trace fossils such as impressions, burrows, and tracks. Geological studies indicate that the reefs and atolls of the Marshall Islands formed 70 to 80 million years ago; however, the natural processes from which atolls are built (U.S. Army Space and Strategic Defense Command, 1993) preclude the occurrence of paleontological remains. There are no National Natural Landmarks.

3.1.5 GEOLOGY AND SOILS

Geology and soils include those aspects of the natural environment related to the earth, which may be affected by the Proposed Action. These features include physiography, geologic units and their structure, the presence/availability of mineral resources, soil condition and capabilities, and the potential for natural hazards.

Region of Influence

The ROI is anticipated to be the proposed locations on Omelek that may be subject to soil compaction and erosion, as well as soil areas within the launch hazard area that have the potential to be subject to contamination from launch exhaust emissions and/or potential contamination from unburned fuel in the event of a terminated launch.

Affected Environment

Geology

The islands and reefs that collectively outline and form the Kwajalein Atoll are typical of other mid-Pacific Ocean atolls in that each was created as a result of prehistoric volcanic islands surfacing above the sea then gradually subsiding below the sea due to deflation of the underlying magma chamber. As the volcanoes subsided below the average sea level, the surrounding ring-shaped coral reefs remained, forming a centralized lagoon. (U.S. Army Space and Strategic Defense Command, 1995)

As a result of similar atoll building processes, Omelek and other land bodies within the mid-Pacific Ocean region have similar geological foundations primarily composed of layers of reef rock. Reef rock is made up entirely of the remains of the previous generations of marine organisms (reef corals, algae, mollusks, echinoderms) that secrete external skeletons of calcium and magnesium carbonate. (U.S. Army Kwajalein Atoll, Marshall Islands, 2004; U.S. Army Space and Strategic Defense Command, 1995)

Soils

Omelek's soils are poor and considered to be low in fertility and almost exclusively composed of calcium carbonate from the accumulation of reef debris and oceanic sediments. Consequently, soils are extremely deficient in major soil constituents such as nitrogen, potash, and phosphorous. Major physical factors which characterize Omelek's soil include coarse soil particles, minimal amounts of organic matter, and alkaline soil pH. In addition, water-holding capacity of the soil is poor due to the generally coarse grained-sands. (U.S. Army Kwajalein Atoll, Marshall Islands, 2004; U.S. Army Space and Missile Defense Command, 2002)

3.1.6 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

In general, hazardous substances (materials) and wastes are defined as those substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, would present substantial danger to public health and welfare or to the environment when released into the environment.

As defined by the Department of Transportation, a hazardous material is a substance or material that is capable of posing an unreasonable risk to health, safety, or property when transported in commerce and has been so designated. Hazardous waste is further defined as any solid waste not specifically excluded which meets specified concentrations of chemical constituents or has certain toxicity, ignitability, corrosivity, or reactivity characteristics.

Regulations governing hazardous material and hazardous waste management at USAKA/RTS are specified in UES Section 3-6. The UES classify all materials as either general-use, hazardous, petroleum products, or prohibited.

Region of Influence

The ROI for potential impacts related to hazardous materials/wastes would be limited to areas of the atoll to be used for missile launch (Omelek) and related operations, and in areas where hazardous materials are stored and handled (Kwajalein and Omelek islands).

Affected Environment

Omelek Island

Hazardous Materials Management. The use of hazardous materials at USAKA/RTS, including Omelek, is limited primarily to materials used in facility infrastructure support and flight operations, with some additional quantities of hazardous materials used by various test operations. Hazardous materials used in infrastructure support activities include various cleaning solvents (chlorinated and non-chlorinated), paints, cleaning fluids, pesticides, motor fuels and other petroleum products, and other materials. A hazardous materials management plan is prepared for all hazardous materials or petroleum products shipped to USAKA/RTS. The plan outlines the procedures for storage, use, transportation, and disposal of the hazardous materials or petroleum products. (U.S. Army Space and Missile Defense Command, 2003) These substances are shipped to USAKA/RTS by ship or by air. Upon arrival at USAKA/RTS, hazardous materials to be used are distributed, as needed, to various satellite supply facilities, from which they are distributed to the individual users. Distribution is coordinated through the base supply system; however, the issue of such materials requires prior authorization by the USAKA/RTS Environmental Office to prevent unapproved uses of hazardous materials.

An activity-specific Hazardous Materials Procedure must be submitted to the Commander, USAKA/RTS for approval within 15 days of receipt of any hazardous material or before use, whichever comes first. Hazardous materials to be used by organizations on the test range and its facilities are under the direct control of the user organization, which is responsible for ensuring that these materials are stored and used in accordance with local and federal requirements. The use of all hazardous materials is subject to ongoing inspection by USAKA/RTS environmental compliance and safety offices to ensure the safe use of all materials. The majority of these materials are consumed in operational processes.

Aircraft flight operations conducted at USAKA/RTS involve the use of various grades of jet propellant, which are refined petroleum products (kerosenes). Fuels are stored in above ground storage tanks located on several islands at USAKA/RTS. Fuels are transported to USAKA/RTS in accordance with the UES. Significant quantities of waste fuels are not normally generated since fuels are used up in power generation, flight operations, marine vessels, and vehicle and equipment usage.

Hazardous Waste Management. Hazardous waste treatment or disposal is not allowed at USAKA/RTS under the UES. Hazardous waste, whether generated by USAKA/RTS activities or range users, is collected at individual work sites in waste containers. These containers are labeled in accordance with the waste which they contain and are dated the day that the first waste is collected in the container. Containers are kept at the point of generation accumulation site until full or until a specified time limit is reached. Once full (250 liters [55 gallons]), containers are collected from the generation point within 12 hours and are prepared for transport to the USAKA/RTS Hazardous Waste 90-Day Storage Facility (Building 1521), located on Kwajalein. Each of the point of generation accumulation sites is designed to handle hazardous waste and provide the ability to contain any accidental spills of material, including spills of full containers, until appropriate cleanup can be completed. (U.S. Space and Missile Defense Command, 2003)

At the 90-Day Storage Facility any sampling of waste is performed (for waste from uncharacterized waste streams), and waste is prepared for final off-island shipment for disposal. Wastes are shipped off-island within 90 days of arrival at Building 1521 to Honolulu on the

supply barge, for treatment and disposal in the continental United States (U.S. Army Space and Missile Defense Command, 2003). The barge departs Kwajalein every 4 weeks.

In accordance with the UES, USAKA/RTS has prepared a Kwajalein Environmental Emergency Plan for responding to releases of oil, hazardous materials, pollutants, and contaminants to the environment. The Kwajalein Environmental Emergency Plan is a contingency plan similar to a spill prevention, control, and countermeasure plan, but it incorporates response provisions of a National Contingency Plan. The hazardous materials management plan is incorporated into the Kwajalein Environmental Emergency Plan.

Pollution prevention, recycling, and waste minimization activities are performed in accordance with the UES and established contractor procedures in place at USAKA/RTS. The Installation Restoration Program is not applicable to USAKA/RTS, since it is located in a foreign country. Remedial action is performed as needed, in accordance with the UES.

Liquid Propellants and Other Toxic Fuels. Existing procedures ensure safe handling of liquid propellants and other toxic materials.

Kwajalein Island

Hazardous Materials Management. As discussed above, the use of hazardous materials at USAKA/RTS is limited primarily to materials used in facility infrastructure support and flight operations, with some additional quantities of hazardous materials used by various test operations. Hazardous materials at Kwajalein are handled in accordance with the UES, federal, DoD, U.S. Army, and U.S. Air Force hazardous materials management requirements.

Hazardous Waste Management. Hazardous waste generated on Kwajalein is handled in accordance with the procedures specified in the UES as discussed above.

Liquid Propellants and Other Toxic Fuels. Existing procedures ensure safe handling of liquid propellants and other toxic materials. Current operations include storage and handling of ground-based interceptor missile and exoatmospheric kill vehicle propellants.

3.1.7 HEALTH AND SAFETY

Health and safety includes consideration of any activities, occurrences, or operations that have the potential to affect one or more of the following:

The well-being, safety, or health of workers—Workers are considered to be persons directly involved with the operation producing the effect or who are physically present at the operational site.

The well-being, safety, or health of members of the public—Members of the public are considered to be persons not physically present at the location of the operation, including workers at nearby locations who are not involved in the operation and the off-base population. Also included within this category are hazards to equipment and structures.

Region of Influence

The ROI for potential impacts to worker health and safety at USAKA/RTS includes the areas where missile components would be stored and handled (Omelek and Kwajalein islands) and where launch (Omelek) and post-launch activities would occur. The worker population of concern for the Proposed Action includes all of USAKA/RTS, but would predominantly consist of the personnel directly involved with Falcon launch program operations.

The ROI for potential impact to public health and safety encompasses all 11 islands of Kwajalein Atoll and other nearby atolls that could be affected by the proposed activities including pre-launch transport of missile components, missile launch, and missile flight. A launch failure could potentially involve an explosion, missile debris, release of toxic materials into the air or water, high noise levels, and/or fire. The population of concern for the Proposed Action consists of the community living on the various atolls and low-lying islands that compose the RMI and any Marshallese people temporarily staying on Omelek while fishing from Gellinam and Eniwetak.

Affected Environment

Omelek Island

Range Safety. Missions on USAKA/RTS are conducted with the approval of the USAKA/RTS Commander. A specific procedure is established to ensure that such approval is granted only when the safety of all proposed tests has been adequately addressed.

Range safety is accomplished by compliance with USAKA/RTS regulations and the use of established procedures and safety precautions to prevent injury to people and minimize damage to property. Range safety applies to preparation, testing, and execution of programs on USAKA/RTS. Other range safety objectives are the successful completion of mission objectives.

All program operations must receive the approval of the Safety Office. This is accomplished by the user through presentation of the proposed program to the Safety Office. All safety analyses, Standard Operating Procedures, and other safety documentation applicable to those operations affecting USAKA/RTS must be provided, along with an overview of mission objectives, support requirements, and schedule. The Safety Office evaluates this information and ensures that all USAKA/RTS safety requirements, as specified in the Safety Manual and supporting regulations, are followed. (U.S. Army Space and Strategic Defense Command, 1995)

Ground Safety. Ground safety is the protection of range personnel and the public from injury when conducting potentially hazardous operations and handling hazardous materials. Several of the islands are affected by building construction, the storage and assembly of explosives and rocket propellants, and the operation of heavy equipment. Kwajalein, Roi-Namur, Meck, Omelek, and Illeginni islands are, or in the past have been, sites for assembling and launching missiles.

Explosives are used at USAKA/RTS for missile flight programs and for destruction of unexploded ordnance, fireworks, small arms rounds, and flares. Small amounts of explosives are used in missile launches for stage separation and flight termination systems, which destroy in-flight missiles that show abnormal flight characteristics. Explosives are stored on Kwajalein, Roi-Namur, and Meck.

Launch facilities consist of structures used for the assembly and launch of missiles that contain experimental payloads. The primary structures are MABs, payload assembly buildings, launch control buildings, and launch pads. The site plans of launch facilities are reviewed and approved by the DoD Explosives Safety Board before construction begins. These structures are spaced according to explosive safety quantity-distance criteria defined in Army Regulation 385-64, *U.S. Army Explosives Safety Program*, and other regulations. Launches on smaller islands may be done remotely, when building separation is insufficient to protect personnel. The number of personnel working at launch facilities is limited during missile assembly and other potentially hazardous operations.

The ground safety plans for programs at USAKA/RTS contain emergency procedures for response to potential accident scenarios. For example, the emergency procedures for a missile launch program include the response to misfire and hangfire conditions, an explosion or fire on the launch pad, and the impact of an errant missile flight. Fire protection is provided by fire suppression systems in most operations buildings, and by continuously staffed fire stations, on Kwajalein, Roi-Namur, and Meck islands. No fire station is located on Omelek (U.S. Army Kwajalein Atoll, Marshall Islands, 2004).

Flight Safety. Flight safety provides protection to USAKA/RTS personnel, inhabitants of the Marshall Islands, and ships and aircraft operating in areas potentially affected by these missions. Specific procedures are required for the preparation and execution of missions involving aircraft, missile launches, and reentry payloads. These procedures include regulations, directives, and flight safety plans for individual missions. The area affected by aircraft and missile operations varies according to the type of mission.

Flight safety activities include the preparation of a flight safety plan that includes evaluating risks to inhabitants and property near the flight, calculating trajectory and debris areas, and specifying range clearance and notification procedures.

Notification is made to inhabitants near the flight path, and international air and sea traffic in the caution area designated for specific missions. Notices to Mariners (NOTMARs) and Notices to Airmen (NOTAMs) are transmitted to appropriate authorities to clear caution areas of this traffic and to inform the public of impending missions. The warning messages contain information describing the time and area affected and safe alternate routes. RMI is informed in advance of launches and reentry payload missions.

In missions that involve the potential for reentry debris near inhabited islands, precautions are taken to protect personnel. In Mid-Atoll hazard areas, where an island has a high probability of impact by debris, personnel are evacuated. In caution areas, where the chance of debris impact is low, precautions may consist of evacuating or sheltering non-mission-essential personnel. Sheltering is required for reentry vehicle missions impacting the Mid-Atoll Corridor in Kwajalein Atoll. The Mid-Atoll Corridor is declared a caution area when it contains a point of impact.

Instrumentation is used for range safety by tracking incoming reentry vehicles and terminating missile flights in order to prevent an impact on inhabited islands. The Kwajalein Range Safety System links the USAKA/RTS radar system to a range safety center on Kwajalein. A missile and payload can be tracked during the entire flight by the range safety center. Missiles launched from USAKA/RTS are equipped with flight termination systems that allow destruction

of the missile if the flight deviates significantly from planned criteria or otherwise poses a threat to the public. For example, a flight would be terminated if the missile path intersects a protection circle, an artificial boundary around inhabited atolls and islands in the Marshall Islands.

Kwajalein Island

Kwajalein is the center of USAKA/RTS operations and has activities that include receiving fuels, propellants, and explosives; maintaining aircraft vehicles and other equipment; providing electricity, water, and waste disposal services; and conducting specialized testing activities. Range, ground, and missile flight safety procedures are discussed above.

USAKA/RTS Sensor Complex. Electromagnetic radiation emitted from USAKA/RTS radars is a potential hazard to humans and a potential source of interference with other communications and sensing equipment. Radars and radiofrequency (RF) transmitters emit non-ionizing radiation. Communications emissions are generally of low frequency and low emitted power and pose minimal threat.

According to a USASMDC fact sheet (U.S. Army Space and Missile Defense Command, undated), the USAKA/RTS complex of radar, optical, and telemetry sensor instrumentation includes: radars that provide precision metric, signature, and imaging for deep-space operations, satellite observations, strategic reentry missions, and multiple-intercept engagement tracking; optics equipped with video, infrared, and film sensors to provide precise optical metric data; and telemetry that receives critical onboard information from airborne vehicles.

Radar systems have mechanical and software stops to prevent the main beam from being directed at the ground or in specified sectors where it may present a hazard. Radars have the potential to interfere with aircraft instrumentation. More powerful radars, such as TRADEX, have computer-controlled interlocks to reduce power output in the direction of approaching aircraft.

Regional Safety

The Kwajalein Hospital is the primary health care facility for USAKA/RTS. The approximate 16-bed hospital has a dental clinic and provides emergency treatment, surgical, obstetric, general medical and diagnostic services for the community and range personnel. One medical technician staffs a dispensary located on Roi-Namur. A first aid station on Meck is also staffed by a medical technician. The hospital, dispensary, and first aid station are contractor operated and staffed. Video consultations with Tripler Army Medical Center in Honolulu, Hawaii provide access to medical specialists for those patients requiring supplemental evaluation. Medical specialists such as optometrists schedule periodic visits to Kwajalein. Other health facilities in the RMI include a private clinic on Majuro and a public hospital on Ebeye.

3.1.8 INFRASTRUCTURE

Infrastructure addresses transportation routes and those facilities and systems that provide water, wastewater treatment, the collection and disposal of solid waste, and power.

Region of Influence

The ROI for infrastructure includes any of Omelek's on-island utility systems or structures, as well as any modes of transportation. The latter can encompass areas leading to the island.

Affected Environment

Transportation

Omelek does not have any paved roads, nor does it house any motor vehicles. Roads on Omelek are predominately unformed tracks, a common occurrence on several USAKA islands (Asian Development Bank, 2001).

The Omelek harbor is periodically dredged and is therefore capable of accepting marine transport. There is an abandoned pier (Facility 07401) and marine ramp (Facility 07402) available at the harbor. (U.S. Army Kwajalein Atoll, Marshall Islands, 2004) Omelek has a 900-square meter (10,000-square foot) helipad, Facility 07400, and is serviced by UH-1H helicopters. (U.S. Army Kwajalein Atoll, Marshall Islands, 2004; U.S. Army Space and Strategic Defense Command, 1995)

Utilities

Water. Inadequate supplies of potable water are common in the area (Central Intelligence Agency, 2004); Omelek does not have an active, developed potable water system, making it necessary for personnel working thereon to carry water for consumption and other uses (U.S. Army Space and Strategic Command, 1995).

Wastewater. Abandoned restrooms exist on Omelek in Facility 07428 (U.S. Army Kwajalein Atoll, Marshall Islands, 2004). Omelek has a leach field on its southern end which contains a septic tank that can be pumped as needed. Wastes from this tank are transported to the wastewater treatment plant at Kwajalein via a pump truck. (Sims, 2004c)

Solid Waste. The minimal quantities of solid waste generated on Omelek are collected and transported to Kwajalein for disposal (U.S. Army Space and Strategic Defense Command, 1993).

Electricity. A network of communication lines and underground electrical lines is found on Omelek, as are an associated generator building (Facility 07406) and communications equipment shed. The abandoned Facility 07406, formerly employed as a power plant, currently contains no generators. (U.S. Army Kwajalein Atoll, Marshall Islands, 2004; U.S. Army Space and Strategic Defense Command, 1993)

3.1.9 NOISE

Under 29 CFR 1910.95, *Occupational Noise Exposure*, employers are required to monitor employees whose exposure to hazardous noise could equal or exceed an 8-hour time weighted average of 85 A-weighted decibels (dBA).

Region of Influence

The ROI for noise analysis is the area within the maximum sound level = 85 decibel (dB) contours generated by proof-of-principle launches and activities. As a conservative method, the ROI for Omelek is a circular area with a 12-kilometer (7.5-mile) radius, centered on the proposed launch site.

Affected Environment

The primary sources of man-made noises on Omelek include helicopter operations and infrequent launching of meteorological rockets. Since Omelek has been developed as a launch support facility and has no inhabitants occupied in unrelated activities, aside from personnel no noise-sensitive receptors have been identified. The nearest inhabited island to Omelek is Gugeegue, which is approximately 21 kilometers (13 miles) away and considered to be outside of the ROI.

3.1.10 WATER RESOURCES

This section describes the existing water resource conditions at the proposed sites. Water resources include surface water, groundwater, water quality, and flood hazard areas.

Region of Influence

The ROI for water resources includes those surface and groundwater bodies that could potentially be affected by program activities.

Affected Environment

Surface Water

Omelek's tropical marine climate is characterized by a relatively high annual rainfall. With the exception of transient shallow pools of rainwater, no surface water bodies exist on the island due to the extreme high porosity and permeability of the soils and surface sediments. (U.S. Army Space and Missile Defense Command, 2002)

Groundwater

As rainwater percolates down through the highly porous and permeable atoll surface, it collects as a lens of fresh groundwater that floats atop marine waters in the subsurface rock strata (U.S. Army Strategic Defense Command, 1989a; b). Omelek contains some brackish groundwater. Potable water requirements are provided by Kwajalein and transported to Omelek to supply individual program requirements.

Water Quality

Freshwater quality in the ROI is generally satisfactory. However, water quality is a constant concern because of the uncertainty of rainwater supply and the limited amount of freshwater in the groundwater lens.

Marine water quality around USAKA/RTS islands has generally been described as satisfactory. According to the UES (U.S. Army Space and Missile Defense Command, 2003), stringent provisions are provided for surface waters as well as general and specific use categories and water quality standards. Discharges to surface waters are required to meet operational and

effluent limits established through Documents of Environmental Protection and water quality management planning.

Flood Hazard Areas

No flood hazard areas have been identified within the ROI of the Proposed Action.

3.2 OPEN OCEAN

For purposes of this analysis, open ocean refers to those ocean areas beyond U.S. and RMI territorial limits as described for each launch alternative. Open ocean areas are subject to Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. A limited number of resources would potentially be impacted by the Proposed or Alternative Action, including airspace, biological resources, health and safety, transportation, and water resources.

3.2.1 AIRSPACE

A general description of airspace is provided in the first paragraph of section 3.1.2.

Region of Influence

The ROI is defined as those portions of the international airspace over the open Pacific Ocean that would potentially be affected by the Proposed Action.

Affected Environment

The affected airspace in the open ocean ROI is described below in terms of its principal attributes, namely controlled and uncontrolled airspace, special use airspace, en route airways and jet routes, and air traffic control. There are no military training routes in the ROI.

Controlled and Uncontrolled Airspace

Because the airspace over the open ocean beyond the territorial limits of the United States and the RMI is in international airspace, the procedures of the ICAO are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in the ROI is managed by the Honolulu and Oakland ARTCCs.

Special Use Airspace

There is no special use airspace in the Ocean Area ROI.

En Route Airways and Jet Routes

The Ocean Area airspace use ROI has several en route high altitude jet routes (A331, A332, A450, R463, R464, R465, R 584, Corridor V 506, and Corridor G 10), which pass through the ROI. Most of the Ocean Area airspace use ROI is well removed from the jet routes that currently crisscross the North Pacific Ocean (figure 3-2).

As an alternative to aircraft flying above 8,839 meters (29,000 feet) following published, preferred instrument flight rules routes, the FAA is gradually permitting aircraft to select their

own routes. This Free Flight program is an innovative concept designed to enhance the safety and efficiency of the National Airspace System. The concept moves the National Airspace System from a centralized command-and-control system between pilots and air traffic controllers to a distributed system that allows pilots, whenever practical, to choose their own route and file a flight plan that follows the most efficient and economical route. (Federal Aviation Administration, 1998)

Free Flight is already underway, and the plan for full implementation will occur as procedures are modified, and technologies become available and are acquired by users and service providers. This incremental approach balances the needs of the aviation community and the expected resources of both the FAA and the users. Advanced satellite voice and data communications are being used to provide faster and more reliable transmission to enable reductions in vertical, lateral, and longitudinal separation, more direct flights and tracks, and faster altitude clearances (Federal Aviation Administration, 1998). With full implementation of this program, the amount of airspace in the ROI that is likely to be clear of traffic will decrease as pilots, whenever practical, choose their own route and file a flight plan that follows the most efficient and economical route, rather than following the published jet routes.

Air Traffic Control

Control of oceanic air traffic from/to the United States is carried out from oceanic centers in Anchorage, Oakland, and New York. The Oakland Oceanic Flight Information Region is the world's largest, covering approximately 48.4 million square kilometers (18.7 million square miles) and handling over 560 flights per day. Traffic between the Continental United States and Hawaii flies on the Central East Pacific Composite Route System. (Federal Aviation Administration, 2000)

3.2.2 BIOLOGICAL RESOURCES

Marine biology of the open ocean area consists of the animal and plant life that lives in and just above the surface waters of the sea and its fringes, the salient physical and chemical properties of the ocean, biological diversity, and the characteristics of its different ecosystems or communities.

Region of Influence

The open ocean area ROI includes those areas below the potential Falcon flight corridors and the first stage, fairing, and second stage drop areas in the central North Pacific Ocean. The average depth of the Ocean Area ROI is 3,932 meters (12,900 feet).

Affected Environment

The general composition of the ocean includes water, sodium chloride, dissolved gases, minerals, and nutrients. These characteristics determine and direct the interactions between the seawater and its inhabitants. The most important physical and chemical properties are salinity, density, temperature, pH, and dissolved gases. For oceanic waters, the salinity is approximately 35 parts of salt per 1,000 parts of seawater.

Most organisms have a distinct range of temperatures in which they may thrive. A greater number of species live within the moderate temperature zones, with fewer species tolerant of extremes in temperature.

Surface seawater often has a pH between 8.1 and 8.3 (slightly basic), but generally is very stable with a neutral pH. The amount of oxygen present in seawater will vary with the rate of production by plants, consumption by animals and plants, bacterial decomposition, and surface interactions with the atmosphere. Most organisms require oxygen for their life processes. Carbon dioxide is a gas required by plants for photosynthetic production of new organic matter. Carbon dioxide is 60 times more concentrated in seawater than it is in the atmosphere.

Ocean Zones

Classification of the Pacific Ocean zones is based upon depth and proximity to land. Using this methodology, there are four major divisions or zones in the ocean: the littoral zone, the coastal zone, the offshore zone, and the pelagic zone. Spanning across all zones is the benthic environment, or sea floor. This section discusses the pelagic zone and the benthic environment.

The pelagic zone is commonly referred to as the open ocean. The organisms that inhabit the open ocean typically do not come near land, continental shelves, or the seabed. Approximately 2 percent of marine species live in the open ocean.

The bottom of the sea floor is known as the benthic area. It comprises 98 percent of the species of animals and plants in the ocean. Less than 1 percent of benthic species live in the deep ocean below 2,000 meters (6,562 feet).

Biological Diversity

Marine life ranges from microscopic one-celled organisms to the world's largest animal, the blue whale. Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, the photic zone, which extends to only about 101 meters (330 feet) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths.

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton consists of plant-like organisms and animals that drift with the ocean currents, with little ability to move through the water on their own. The nekton consists of animals that can swim freely in the ocean, such as fish, squids, and marine mammals. Benthic communities in the vicinity of Omelek are made up of marine organisms, such as kelp, sea grass, giant clams, top-shell snails, black-lipped pearl oysters, sponges, coral, sea cucumbers, sea stars, and crabs that live on or near the sea floor (U.S. Army Space and Missile Defense Command, 2004).

Threatened and Endangered Species

Species identified as threatened or endangered that exist in the Ocean Area ROI, listed in section 3.1.3, include the sei whale, blue whale, finback whale, humpback whale, sperm whale, loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and olive ridley sea turtle.

Noise

Baseline or ambient noise levels on the ocean surface—not including localized noise attributed to shipping—is a function of local and regional wind speeds. Studies of ambient noise of the ocean have found that the sea surface is the predominant source of noise, and that the source

is associated with the breaking of waves. Wave breaking is further correlated to wind speed, resulting in a relationship between noise level and wind speed. (Federal Aviation Administration, July 2001)

Ambient noise in relation to underwater noise is also the existing background noise of the environment. Ambient noise strongly affects the distances to which animal and specific man-made sounds and other sounds of interest can be detected by marine mammals (Richardson et al., 1995). Common sources of background noise for large bodies of water are tidal currents and waves; wind and rain over the water surface; water turbulence and infrasonic noise; biological sources (e.g., marine mammals); and human-made sounds (e.g., ships, boats, low-flying aircraft). The ambient noise levels from natural sources typically vary by as much as 20 dB or more (Richardson et al., 1995) according to numerous factors including wind and sea conditions, seasonal biological cycles, and other physical conditions. Noise levels from natural sources can be as loud as 120 dB (re: 1 micropascal [µPa] at 1 meter [3.2 feet]) in major storms. (U.S. Department of the Air Force, 1998)

Noise associated with human sources varies with the characteristics of the specific noise source. The primary human-made noise source within the ROI is expected to be associated with ship and vessel traffic. This source may include transiting commercial tankers and container ships, commercial fishing boats, and military surface vessels and aircraft. Vessel noise is primarily associated with propeller and propulsion machinery. In general, noise levels increase with vessel size, speed, and load. Noise levels from large ships can reach levels of 180-190 dB (re 1 µPa at 1 meter [3.2 feet]), whereas smaller vessels range from approximately 100-160 dB (re 1 µPa at 1 meter [3.2 feet]) (U.S. Department of the Air Force, 1998). At distances greater than 1 meter (3.2 feet), noise levels received diminish rapidly with increasing distance (Richardson et al., 1995).

Water Resources

A general description of water resources is provided in the first paragraph of section 3.1.11.

Water quality in the open ocean is excellent, with high water clarity, low concentrations of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons. A description of the open ocean's physical and chemical properties, including salinity, density, temperature, pH, and dissolved gases, is given above.

3.2.3 HEALTH AND SAFETY

A general description of health and safety is provided in the beginning paragraphs of section 3.1.7.

Region of Influence

The open ocean ROI consists of all areas beneath the proposed flight track where there is the potential for impact of missile components during planned activities or abnormal flight termination and the broad ocean area where the missile's first stage and missile debris would impact.

Affected Environment

The affected health and safety environment for the open ocean is described below in terms of its principal attributes, namely range control procedures and verification of ocean area clearance procedures.

Range Control is charged with surveillance, clearance, and real-time range safety. The Range Control Officer using USAKA/RTS assets is solely responsible for determining range status and setting “RED” (no firing) and “GREEN” (range is clear and support units are ready to begin the event) range firing conditions. USAKA/RTS uses Range Commanders Council (RCC) 321-02, *Common Risk Criteria for National Test Ranges*. RCC 321-02 sets requirements for minimally-acceptable risk criteria to occupational and non-occupational personnel, test facilities, and non-military assets during range operations. Under RCC 321-02, individuals of the general public shall not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million on an annual basis.

Flight Safety provides protection to USAKA personnel, inhabitants of RMI, and ships and aircraft operating in areas potentially affected by mission activities. Specific procedures, including regulations, directives, and flight safety plans, are required for the preparation and execution of missions involving aircraft, missile launches, and reentry payloads. USAKA controls all flight corridor operations as part of USAKA/RTS. All operations are thus conducted in accordance with safety procedures, which are consistent with those implemented for USAKA/RTS. There is no special use airspace over USAKA/RTS.

4.0
ENVIRONMENTAL CONSEQUENCES

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of the proposed activities by comparing these activities with the potentially affected environmental components. Section 4.1 and 4.2 provide discussions of the potential environmental consequences of these activities. The amount of detail presented in each section is proportional to the potential for impacts. Sections 4.3 through 4.9 provide discussions of the following with regard to proposed program activities: cumulative impacts; environmental effects of the No-action Alternative; adverse environmental effects that cannot be avoided; conflicts with federal, state, and local land use plans, policies, and controls for the area concerned; energy requirements and conservation potential; irreversible or irretrievable commitment of resources; relationship between short-term use of the human environment and the maintenance and enhancement of long-term productivity; and natural or depletable resource requirements and conservation potential.

To assess the potential for and significance of environmental impacts from the proposed program activities, a list of activities was developed (chapter 2.0) and the environmental setting was described, with emphasis on any special environmental sensitivities (chapter 3.0). Program activities were then assessed with the potentially affected environmental components to determine the environmental impacts of the proposed activities.

To help define the affected environment and determine the significance of program-related effects, written, personal, and telephone contacts were made with applicable agencies and installations. Chapter 7.0 provides a list of those contacted, and appendix B provides copies of correspondence from the agencies.

4.1 U.S. ARMY KWAJALEIN ATOLL, OMELEK ISLAND

4.1.1 AIR QUALITY

This section addresses potential environmental impacts caused by changes to the air quality environment due to the Proposed Action at Omelek.

Site Preparation Activities

Site preparation activities would include minimal modifications to the existing Omelek launch site (the pier and harbor, generator building, communications building, restrooms, and the fuel storage area), the addition of two new mooring buoys, construction of a new launch pad and MAB, the relocation of the J.A. Jones building from Roi Namur to Omelek, the construction of a new walkway from the pier to the island, the addition of a new diesel fuel storage tank, the construction of a new concrete pad to support the LOX plant and storage tanks, clearing vegetation, road work, and the possible demolition of existing facilities. These activities are not anticipated to substantially impact the regional air quality. Construction would be conducted in accordance with applicable regulations and permits and would be both temporary and localized in nature. Once construction is completed, air quality would return to its former level.

Launch preparation activities would also include the arrival of SpaceX equipment via a commercial cargo carrier and a landing craft, as well as the transportation of launch personnel. Emissions produced during these activities would be temporary and localized and are not anticipated to affect regional air quality.

Operational Activities

Two 500-kilovolt diesel generators would be used for power on Omelek. A worst-case scenario for the generators would have each generator running for 528 hours per launch. Additionally, up to a 7.5-kilowatt, gasoline powered generator would be used to run the floating water pump. For analysis purposes a 10 minute running time was used. Emissions from this 7.5-kilowatt generator would be considered negligible as they would be less than a pound for each criteria pollutant. Table 4–1 lists the possible exhaust emissions associated with the proposed two 500-kilovolt generators. These levels of emissions are considerably below the threshold levels listed in table 3-2 and are not anticipated to impact the regional air quality or exceed the ambient air quality standards listed in table 3-1.

Table 4-1: Potential Generator Emissions
Metric Tons (Tons) Per Launch

	Volatile Organic Compounds[(1)]	Oxides of Nitrogen	Carbon Monoxide	Oxides of Sulfur	PM-10
Two 500-kilovolt generators	0.81 (0.89)	9.96 (10.97)	2.14 (2.36)	0.66 (0.73)	0.71 (0.78)

Source: Calculations based on emission factors from AP-42, Fifth Edition, Volume 1
(1) Total Organic Compounds
PM-10 = particulate matter with a diameter less than or equal to 10 micrometers

If LOX and liquid nitrogen are not brought to the island, the LOX plant would go into production once personnel arrive at Omelek and would not operate between missions. Emissions for energy and power requirements for the LOX plant are included in table 4-1 and would not increase potential generator emissions. LOX fueling operations would involve pumping LOX through aboveground lines between the LOX plant and the launch vehicle. Any emissions of LOX during this process would be negligible and would not have a negative impact to surrounding air quality. Liquid nitrogen, also produced by the LOX plant, would be used to cool the loading and handling LOX equipment. In the event of a spill, the LOX or liquid nitrogen would be allowed to evaporate and would not impact the surrounding regional air quality.

Kerosene would be used as a fuel for the Falcon and would be pumped to the launch vehicle via an over-the-road transport trailer and lines between the loading equipment and the launch pad. Any kerosene spills that occur during the fueling process would be contained and cleaned up in accordance with the USAKA/RTS spill containment procedures, and therefore are anticipated to have no contribution to the overall emissions generated during the flight test activities.

Each launch is considered to be a discrete event that generates short-term impacts to the local air quality. Long-term effects resulting from launches are not expected because the launches would be infrequent and the resulting emissions would be rapidly dispersed and diluted by winds. Table 4-2 lists the anticipated emissions of criteria pollutants from a single Falcon launch. These levels are below the threshold levels listed in table 3-2 and are not anticipated to impact the regional air quality or exceed the ambient air quality standards listed in table 3-1.

A Falcon launch would also emit hydrogen, carbon dioxide, and water; however, these emissions are not regulated and would not cause an impact to the regional air quality.

Table 4-2: Single Falcon Launch Emissions
Metric Tons (Tons) Per Launch

	Volatile Organic Compounds	Oxides of Nitrogen	Carbon Monoxide	Oxides of Sulfur	PM-10
Single Falcon Launch	0.0 (0.0)	0.0 (0.0)	86.4 (95.2)	0.0 (0.0)	0.0 (0.0)

Source: Space Exploration Technologies Corporation, 2003
PM-10 = particulate matter with a diameter less than or equal to 10 micrometers

Post Flight Activities

Activities performed during post-flight would include the removal of equipment and assets brought to Omelek. The removal could result in small localized amounts of fugitive dust, which would have a negligible impact to air quality.

Cumulative Impacts

Due to the limited industrialization of Omelek and the surrounding environment, the potential cumulative impacts to air quality due to the proposed flight testing activities would not be substantial. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. There are currently no other activities planned at Omelek. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Missile launches are short-term, discrete events, thus allowing time between launches for emission products to be dispersed. It is not likely that the Proposed Action at Omelek would result in cumulative impacts to the regional air quality.

4.1.2 AIRSPACE

Assessment of potential impacts to airspace is based on the following: if proposed activities have the potential to result in an obstruction to air navigation; modification to or new requirements for special use airspace; changes to existing air routes; or additional restricted access to regional airfields and airports.

Site Preparation Activities

Although site preparation activities could involve flights in and out of Bucholz Army Airfield on Kwajalein, they would not restrict access to, nor affect the use of, existing airfields and airports in the ROI. Operation at the airfield would continue unobstructed. Similarly, the existing airfield or airport arrival and departure traffic flows would not be affected. No modification to or new requirements for special use airspace would be required. No changes to existing air routes or additional restricted access to regional airfields and airports are anticipated. All arriving and departing aircraft and all participating military aircraft are under the control of the Bucholz Army Airfield Control Tower; thus, there would be no airfield conflicts in the ROI, and no effect.

Operational Activities

USAKA/RTS is located under international airspace and, therefore, has no formal airspace restrictions governing it. Commercial and private aircraft would be notified in advance of Falcon launch activities by USAKA/RTS as part of their routine operations through NOTAMs by the FAA.

To satisfy airspace safety requirements in accordance with Army Regulation 385-62, *Regulations for Firing Guided Missiles and Heavy Rockets for Training, Target Practice, And Combat*, the responsible commander would coordinate with the Administrator, FAA, through the appropriate U.S. Army airspace representative as required by Army Regulation 95-2, *Air Traffic Control, Airspace, Airfields, Flight Activities, and Navigational Aids*. Provision would be made for surveillance of the affected airspace in accordance with Army Regulation 385-62. In addition, safety regulations dictate that launch operations would be suspended when it is known or suspected that any unauthorized aircraft have entered any part of the airspace above the launch hazard zone until the unauthorized entrant has been removed or a thorough check of the suspected area has been performed. No new special use airspace would be required. NOTAMs would be issued to advise avoidance of the tracking radar areas during activation of the USAKA Range, particularly in the vicinity of Kwajalein or Roi-Namur when their radars are transmitting.

Although Omelek is approximately 35 kilometers (22 miles) north of Bucholz Army Airfield, some of the desired azimuths shown on figure 2-5 could impact standard flight patterns for military aircraft coming to Kwajalein from Hawaii. SpaceX would coordinate Falcon launches with the USAKA/RTS Commander, which would include scheduling to avoid airspace conflicts.

Post Flight Activities

Flights required as part of the post flight activities would not restrict access to, nor affect the use of, existing airfields in the ROI. Operations at the airfields would not be obstructed. Existing airfield or airport arrival and departure traffic flows would also not be affected and access to the airfield would not be curtailed. All arriving and departing aircraft and all participating military aircraft are under the control of the Bucholz Army Airfield Control Tower; thus, there would be no airfield conflicts in the ROI, and no impact.

Cumulative Impacts

Missile launches are short-term, discrete events and are actively managed by USAKA/RTS range safety. The Proposed Action would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. No other projects in the ROI have been identified that would have the potential for cumulative impacts to airspace. The use of the required scheduling and coordination process for international airspace, and adherence to applicable DoD directives and U.S. Army regulations concerning issuance of NOTAMs and selection of missile firing areas and trajectories, lessens the potential for significant incremental, additive, cumulative impacts.

4.1.3 BIOLOGICAL RESOURCES

Impacts to biological resources are considered substantial if they have the potential to jeopardize the existence of federally listed threatened or endangered species, degrade biologically important unique habitats, produce substantial long-term loss of vegetation, or reduce the capacity of a habitat to support wildlife and vegetation.

Potential impacts of construction, building modification, and missile launches on terrestrial and marine biological resources within the USAKA/RTS area have been addressed in detail in the documents listed in section 1.5 and in the *USAKA Temporary Extended Test Range Environmental Assessment* (1995), and *Theater High Altitude Area Defense (THAAD) Pacific Test Flights Environmental Assessment* (2002). Effects of Falcon missile launches on Pacific Ocean marine resources were addressed in the *EA for the Falcon Launch Vehicle Program* (2003). Based on these prior analyses and the effects of past missile launches, the potential impacts of planned activities related to the Falcon missile launches on biological resources are expected to be minimal, as discussed below.

All transportation of equipment and materials such as fuels would be conducted in accordance with DoD and Department of Transportation regulations. Adherence to standard operating procedures for spill prevention, containment, and control measures while transporting equipment and materials would preclude impacts to biological resources.

Site Preparation Activities

Vegetation

The options for the Proposed Action indicate that existing non-forested areas would be used for the project; the various options distribute the same buildings and infrastructure slightly differently on the island. Impacts to mature forest, especially *Pisonia* trees, would be avoided (Sims, 2004a). Clearance for the proposed launch pad and associated infrastructure would be primarily placed in areas of grass and forb vegetation which are currently maintained at a low level by mowing or other mechanical control and, as such, already significantly disturbed (see appendix C). Pier refurbishment would not expand the existing pier footprint and is thus not anticipated to result in impacts to adjacent biological resources.

Some *Scaevola* and *Tournefortia* would be removed to enlarge the existing open sites to allow a cleared zone around the proposed launch pad. However, the layout of buildings and infrastructure would not result in the removal of major amounts of native vegetation, nor would it result in direct effects to migratory birds other than disturbance during the project itself. (See appendix C.) No significant impacts to vegetation are expected.

Construction of the new MAB would be conducted in such a manner to avoid impacts on any of the mature, mixed broadleaf forests on the island. Although construction of the MAB under options 1, 2, and 4 would require removal of 2 to 3 small palm trees (Sims, 2004c), young replacement trees would be planted in other areas on the island if one of these options is selected. Siting of the temporary evaporative pond would also avoid impacts on any of the mature, mixed broadleaf forests.

Based on a recent U.S. Fish and Wildlife Service field review of sites potentially required for buildings and infrastructure of the SpaceX proposal, the Proposed Action is not likely to result in the removal of large amounts of native vegetation (see appendix C). Sufficient open space appears to exist at the proposed sites to absorb site preparation impacts on the ground. If either Option 1 or Option 4 is selected by the decision maker, signs would be placed on the north end of Omelek designating sensitive areas. Prior to their arrival on Omelek, SpaceX personnel would be briefed on the need to respect and protect sensitive island resources, including the remaining native forest, and to avoid harassment of sensitive species. Personnel would be instructed to stay on existing roads and paths where possible. Onsite supervisors would ensure that personnel comply with the briefing objectives.

Wildlife

Personnel would be instructed to avoid areas designated as avian nesting or roosting habitat by USAKA/RTS in coordination with the Pacific Islands Fish and Wildlife Service office and to avoid all contact with any nest that may be encountered. Emergency lighting would be shielded and pointed down to minimize the potential for impacts to migratory birds and sea turtles.

Immediately prior to their shipment to Omelek, prefabricated buildings and all other materials would be inspected by a certified pest control inspector and, if necessary, treated for the removal of pests (e.g., rats, mice, and ants) and other non-native organisms to prevent their potential spread and introduction to other USAKA islands.

The effects of noise on wildlife vary from serious to no effect in different species and situations. Behavioral responses to noise also vary from startling to retreat from favorable habitat, due partly to the fact that wildlife can be very sensitive to sounds in some situations and very insensitive to the same sounds in other situations (Larkin, 1996).

Construction noise and the increased presence of personnel could temporarily affect wildlife within the area. Construction ground disturbance and equipment noise-related impacts could include loss of habitat, displacement of wildlife, and short-term disruption of daily/seasonal behavior. Typical noise levels at 15 meters (50 feet) from construction equipment range from 70 to 98 dBA. The combination of increased noise levels and human activity would likely displace some birds that forage, feed, or roost within this 15-meter (50-foot) radius. Although construction activities could cause flushing (birds suddenly flying up), this is a common reaction to sudden natural sounds that only slightly increases the energy expenditure of individual birds, and while some might potentially leave the immediate area permanently, others may likely become accustomed to the increased noise and human presence. As discussed above, actions would be taken to minimize disturbance to sensitive resources, such as laying power and communication cables on the ground in cable trays, posting signs designating sensitive areas on the northern part of the island, and providing personnel with information on the need to protect and avoid harassment of sensitive species. Site preparation activities are therefore not expected to have a long-term significant adverse effect on birds or other wildlife in the ROI.

The employment of at least 557 to 650 square meters (6,000 to 7,000 square feet) of new concrete would result in the more or less permanent removal of habitat available for nesting seabirds or foraging shorebirds on Omelek. However, this would be only approximately 2 percent of the total area of Omelek, which should not have a direct effect on migratory birds. (See appendix C.)

Threatened and Endangered Species

No threatened or endangered vegetation has been identified in the project areas. Personnel would be instructed to avoid all contact with sea turtles or turtle nests that might occur within the area. SpaceX or USAKA/RTS personnel would install fencing 100 meters (328 feet) on either side of the launch site just above the wave surge area at a sufficient height to prevent sea turtles from hauling out on the beach adjacent to the launch site and thus would prevent a take during a nominal launch. No site preparation activities would take place offshore, and thus marine mammals would not be affected.

Environmentally Sensitive Habitat

Harbor improvements and installation of two new mooring buoys at Omelek (figure 4-1) should cause no localized impact to the coral near the existing jetty; the buoys, which would be restricted to sandy bottom areas, are designed to minimize impacts to coral, and this potential impact would be further mitigated through careful site planning and construction practices. The buoys would be sited on sandy bottom areas far enough away from any coral to prevent the chain and line off the pin on the bottom from abrading the coral during rise and fall of the tides. No impacts on environmentally sensitive habitat are expected.

Operational Activities

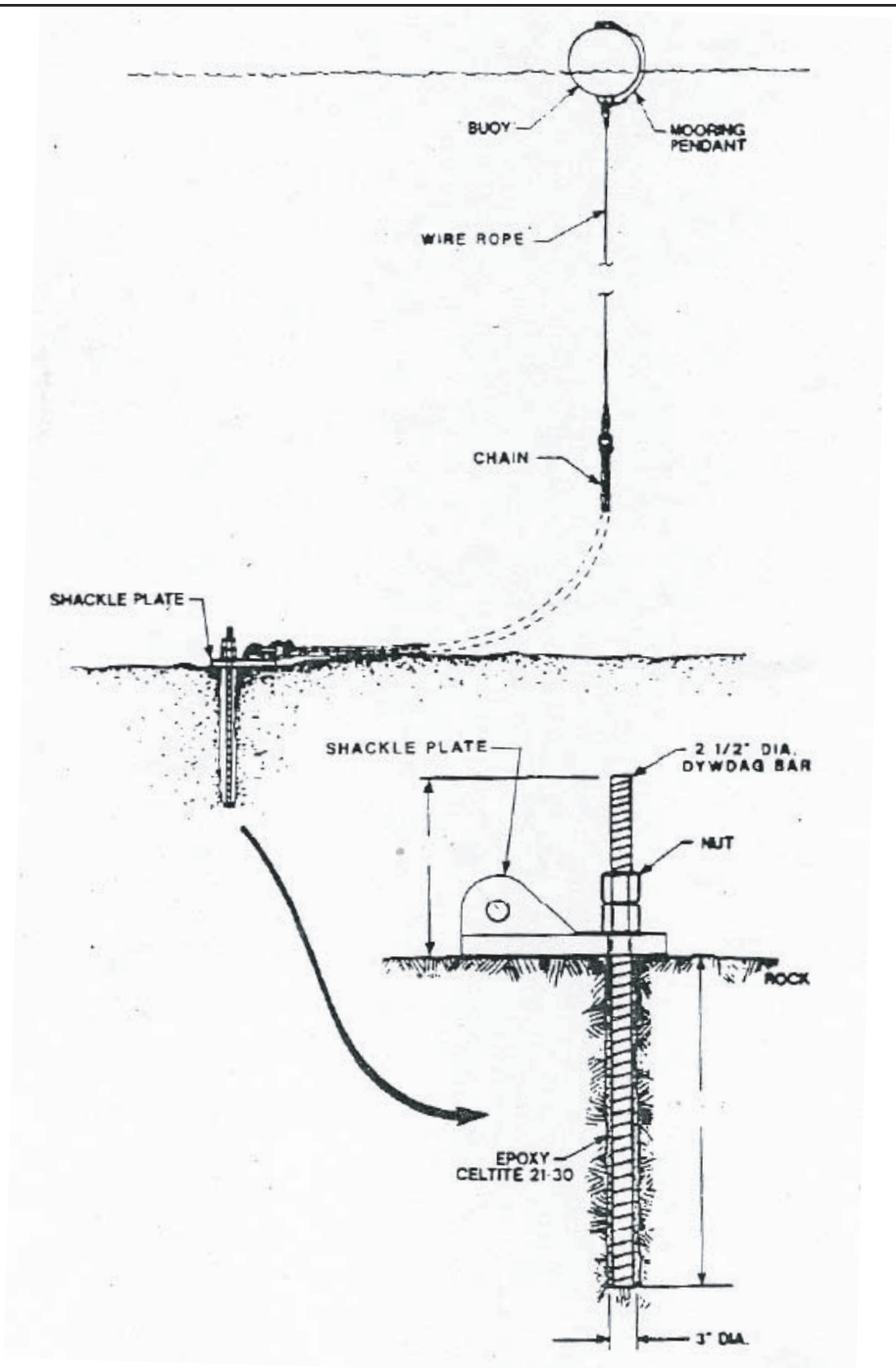
Vegetation

Launch exhaust products would include hydrogen, carbon dioxide, carbon monoxide, and water. The exact size of the expected blast burn or scorch area has not been determined, but it is doubtful with the deluge system in place that this impact would extend more than 15 meters (50 feet) from the pad. Sufficient open space should exist at the launch sites proposed in all four options to absorb ground impacts from a nominal launch (see appendix C), without substantially affecting mature forest trees, such as *Pisonia;* thus, the impact to nearby vegetation should be negligible. (Sims, 2004a)

Wildlife

Disturbance to wildlife from the launches would be brief and is not expected to have a lasting impact nor a measurable negative effect on migratory bird populations. Studies indicate that birds may flush during sharp, loud noises but return to normal behavior within a short time. Wildlife that remain in the area would quickly resume feeding and other normal behavior patterns after a launch is completed. Birds driven from preferred feeding areas by disturbances from aircraft or explosions usually return soon after the disturbance stops, as long as the disturbance is not severe or repeated (Federal Aviation Administration, 1996). No evidence has indicated that serious injuries to wildlife have resulted from prior launches in the region, and no long-term adverse effects are anticipated. The brief noise peaks that would be produced by the Falcon are comparable to levels produced by close-range thunder (120 dB to 140 dB peak). There is no species known to be susceptible to hearing damage following exposure to this noise source (U.S. Department of the Air Force, 2001). The two Falcon launches are not anticipated to result in direct effects to nesting, resting, or roosting birds other than the temporary disturbance during the launch itself.

The exhaust plume produced by the Falcon launch vehicle would consist mainly of steam and carbon dioxide. The carbon dioxide, when mixed with the deluge water, would create carbonic acid, which would then break down into bicarbonate and hydrogen ions and create a mild acid



EXPLANATION

Mooring Buoy

Not to Scale

Figure 4-1

similar to a carbonated beverage. The steam produced is anticipated to have the same pH as rainwater; that, combined with the fact that most of the steam from the exhaust plume is expected to rapidly evaporate, should produce no long-term effects. Therefore, operational activities are not anticipated to have a long-term negative impact on biological resources in the adjacent area. (Space Exploration Technologies Corporation, 2003)

In the unlikely event of an accidental release of stored liquid propellant, emergency response personnel would comply with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX and the Kwajalein Environmental Emergency Plan in order to prevent impacts to biological resources in the vicinity. All applicable safety regulations and requirements would be followed which would also minimize the potential for accidental spills, as well as provide the means for mitigating or minimizing effects to wildlife if an accident were to occur.

A calculation regarding a maximum credible spill of the various propellants and fluids used for the Falcon launch vehicle has been conducted. The maximum credible spill is 100 percent of the first stage main flight tank. Secondary containment of the kerosene storage vessel is assumed to contain any storage vessel leaks or rupture, and leakage of kerosene load lines to the vehicle would be detected prior to an equivalent volume being released. This spill would be contained within the concrete containment system of the launch pad. To prevent accidental ignition of the fluid or vapors during nominal launch activities, all handling equipment involved in the storage, shipping, and loading of kerosene would be grounded to prevent electrostatic discharge.

Spills of LOX, liquid nitrogen, or helium would evaporate quickly and would not require containment. LOX presents both cryogenic and flammability hazards, though it is not toxic to personnel or the environment. To prevent accidental ignition of this fluid during nominal launch activities, all materials coming in contact with LOX would be thoroughly cleaned to remove organic materials that could combust. In addition, all equipment that comes in contact with LOX during storage, shipment, handling, and loading of LOX would be certified LOX compatible.

An early flight termination or mishap on the pad or shortly thereafter, which is not a planned or high probability event, could result in debris impacts to the entire island as well as along the flight corridor. This debris could strike and potentially kill migratory birds and marine species. However, measures are implemented into the launch process to minimize the potential for such occurrences. Should this low probability event occur, SpaceX and USAKA/RTS would evaluate if or how to proceed with cleanup in accordance with the UES. The potential for effects to biological resources would also be evaluated at that time in coordination with the U.S. Fish and Wildlife Service. The Flight Termination System of the Falcon, which disables power to the vehicle engines and disrupts flight, should result in basically a whole body impact into the ocean (see section 4.2.2). The potential ingestion of toxins by fish species, which may be used for food sources, would be remote because of the diluting effect of the ocean water and the relatively small area that would be affected.

Threatened and Endangered Species

As discussed above, an early flight termination or mishap could result in debris impacting along the flight corridor. However, sensitive marine species in this region are widely scattered, and the probability is rather low that migratory whales or sea turtles would be impacted by this falling debris.

The potential for impacts to threatened and endangered marine mammals as a result of planned falling debris and booster drops in the open ocean is discussed in section 4.2.2.

Environmentally Sensitive Habitat

As stated above, the buoys would be sited on sandy bottom areas far enough away from any coral to prevent the chain and line off the pin on the bottom from abrading the coral during rise and fall of the tides. A land-based pump would be connected to an attended intake hose that would be floated into the lagoon and suspended just under the water. No impacts to environmentally sensitive habitat are anticipated from a nominal launch event.

Post Flight Activities

A back-out crew, located at Meck for both mission abort operations and also post-flight operations, would arrive and depart Meck via boat transport. After launch and approval by ground safety, this crew would approach Omelek and begin post-launch procedures. SpaceX personnel would cleanup the launch site. Limited noise and the small increase in fugitive dust produced during these activities are not expected to impact biological resources, and wildlife in particular.

After each proof-of-principle flight, the remaining deluge water would be collected, containerized, and tested. This water would be pumped into drums and removed from Omelek if found to be contaminated. Deluge water determined to be non-contaminated would be pumped into the temporary, bermed evaporative pond. Measures would be taken (e.g., a tent or elevated tarp cover over the pond) that would allow evaporation but also prevent access by birds that could be attracted to the standing water. Contaminated or non-contaminated water would not be discharged into the ocean. These actions would prevent impacts from the deluge to seabirds or shorebirds that might be attracted to the evaporative pond as well as any impacts to seawater surrounding Omelek.

SpaceX would remove all hazardous and non-hazardous waste from Omelek and dispose of it in accordance with USAKA/RTS regulations and UES requirements. No impacts to biological resources are anticipated from these activities.

A habitat enhancement project would be undertaken as a mitigation measure that would benefit the natural environment of Kwajalein Atoll under USAKA jurisdiction to offset the potential impacts of the Falcon Launch Vehicle Program on Omelek. An ant eradication project on Eniwetak would be performed by USAKA/RTS using methods developed and implemented in coordination with the U.S. Fish and Wildlife Service. Use of ant bait that is noninjurious to crabs and other species could be used effectively to control invasive ant species and would produce the desired effect in a relatively short period of time.

Cumulative Impacts

The limited amount of construction planned for Omelek would not likely result in cumulative impacts to biological resources. It is unlikely that the Proposed Action in conjunction with currently planned activities at USAKA/RTS would result in cumulative impacts to the island's biological resources from emissions, noise, or other effects arising from program actions. The ant eradication program proposed as a habitat enhancement on Eniwetak would have a positive cumulative impact on the natural environment of USAKA. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from

Omelek could be considered after the proof-of-principle launches have been completed. No other activities on Omelek are anticipated which, when combined with proposed SpaceX activities, would result in cumulative impacts. Personnel would be instructed on the avoidance of sensitive habitat and species. Missile launches are short-term, discrete events. No significant cumulative impacts to biological resources have been identified as a result of prior or current launch-related activities in the ROI.

4.1.4 CULTURAL RESOURCES

Ground-disturbing activities at Omelek would be planned so that the archaeologically sensitive old broadleaf forest areas would be avoided. If the proposed facilities cannot be located to avoid these areas, a pre-construction intensive sub-surface survey will be performed by a qualified archaeologist to determine what cultural materials may be on the site. Archaeological monitoring with systematic sampling as necessary would accompany construction of any facilities.

Site Preparation Activities

Launch activities have not been conducted at Omelek since 1996. Therefore, SpaceX would need to conduct limited refurbishment of existing buildings, bring in some additional temporary buildings, and make infrastructure improvements in order to prepare a launch facility for the Falcon launch vehicle.

Clearance for the proposed launch pad and associated infrastructure would be primarily placed in areas of grass and forb vegetation which are currently maintained at a low level by mowing or other mechanical control and, as such, already significantly disturbed (see appendix C). The layout of buildings and infrastructure would neither require the removal of major amounts of native vegetation nor the ground-clearing activities associated with such an endeavor.

Operational Activities

Personnel involved in launch and other operational activities would follow UES requirements in handling or avoiding any cultural resources uncovered during operational or monitoring activities. Impacts to cultural resources from routine operational activities would thus be avoided.

Post Flight Activities

Post flight clean-up and evacuation procedures would be handled so as to avoid removal, destruction, or damage to cultural resources. No impacts to cultural resources are expected.

Cumulative Impacts

No cumulative affects to cultural resources have been identified due to prior launch activities. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. No other activities on Omelek have been identified. Overall avoidance would minimize the potential for cumulative impacts concerning cultural resources. Personnel would be instructed of the sensitivity of cultural resources and to avoid any impacts to these resources. Also, ongoing consultation with the RMI Historic Preservation Officer through the USAKA/RTS Environmental Office would continue.

4.1.5 GEOLOGY AND SOILS

This section addresses potential impacts to geology and soils that could result from proposed activities.

Site Preparation Activities

Site preparation activities and other necessary prelaunch activities on Omelek are not expected to result in any adverse geological or soil impacts. Although site preparation activities would subject soils to wind, possible erosion would be minimal due to the short duration and limited to the immediate vicinity of the construction site. Best Management Practices, such as regular watering of excavated material as required, would furthermore reduce the potential for soil erosion.

Operational Activities

Since the Falcon launch vehicles use LOX and kerosene propellants, the emission products (carbon monoxide, carbon dioxide, hydrogen, and water) lack hazardous materials and would consist primarily of steam. Thus, no impacts to geology and soils would occur as a result of launch emissions.

Potential soil contamination could occur in the event of an accidental fuel spill or premature flight termination that resulted in burning/unburned fuel coming in contact with soils. However, in the unlikely event of an accidental release of kerosene, emergency response personnel would comply with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX and the Kwajalein Environmental Emergency Plan. Following these safety regulations and requirements would minimize the potential for accidental spills, as well as provide the means for mitigating or minimizing effects to soils and disposal of the recovered fuel if an accident were to occur. Therefore, the risk of accidental fuel spills during flight test activities would be considered temporary in duration.

Post Flight Activities

Post flight activities would include the usage of fresh water to douse fires and/or for initial cleanup on the pad. Fresh water would also be used to rinse the pad and launch stand prior to securing for storage. Any contaminated soil would be removed from Omelek by SpaceX and disposed of in accordance with USAKA/RTS regulations and the UES. Other than minimal soil compaction, as a result of the removal of all mobile equipment/assets, adverse impacts to the soil from post flight activities would not be considered significant.

Cumulative Impacts

Preparation of the launch site and adherence to established hazardous waste and spill prevention procedures and regulations minimize the potential for any impacts to the soils. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. No other activities on Omelek have been identified. As a result, no cumulative adverse impacts to geology or soils are expected to occur.

4.1.6 HAZARDOUS MATERIAL AND WASTE

This section addresses potential impacts that could result from the storage and use of hazardous materials and the generation and disposal of hazardous waste associated with Falcon launch operations from Omelek.

Site Preparation Activities

All hazardous materials used and waste generated during site preparation activities would be handled, transported, stored, treated, and disposed of off-site in accordance with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX. All construction activities would follow the Kwajalein Environmental Emergency Plan and therefore would have a spill control plan.

Falcon missile components would be brought to Kwajalein as the initial arrival point at USAKA/RTS. Kwajalein would also serve as the supply point for consumable materials to be employed during vehicle preflight assembly and checkout operations. Some of the materials in these consumable supplies are considered to be hazardous materials (e.g., cleaning solvents, motor fuels, and household pesticides). These materials would be stored on Kwajalein in appropriate warehouse facilities before issuance for use on Omelek. These materials are similar to hazardous materials already in use for other operations (including standard facility maintenance activities) and represent only a small increase in the total amount of materials to be handled. The quantity of these materials that would be used represents a *de minimis* increase above those already in use and could, therefore, easily be accommodated by the current hazardous materials management systems.

The Falcon launch vehicle would arrive at Kwajalein fully assembled and installed in its Transporter/Erector system. The Falcon launch vehicle would be fueled on the bermed launch pad at Omelek. The goal is to launch within a few days to one week of payload arrival at the launch site.

In accordance with DoD regulation 5200.2R, *Personal Security Program Regulation* and requirements of the UES, SpaceX personnel would perform pollution prevention, waste minimization, and recycling measures where applicable. Construction activities would be performed in accordance with the USAKA Stormwater Pollution Prevention Plan to minimize potential erosion and stormwater runoff.

Operational Activities

Hazardous Materials Management

The use of hazardous materials during Falcon launch operations would be limited to small amounts of solvent cleaners (e.g., acetone, isopropyl alcohol), and some handling and storage of motor fuels for use in motor vehicle and/or generator systems. These types of hazardous materials are similar to hazardous materials already in use at USAKA/RTS and would result in only a minor increase over current amounts. Use and management of hazardous materials associated with missile launch activities would continue to be performed in accordance with the requirements of the UES and the USAKA/RTS Range Safety office. Personnel trained in the appropriate procedures to handle potentially hazardous materials would be on standby.

During normal flight operations there would be no hazardous materials issues associated with flight corridors. If an in-flight malfunction occurs, the range safety officer may initiate flight termination, resulting in missile debris being deposited beneath the flight path. The potential effects on the ocean environment from hazardous materials associated with missile debris are discussed in Section 4.2.3, Health and Safety, and have been analyzed in previous NEPA documents, such as the THAAD EA (U.S. Army Space and Missile Defense Command, 2002), with the conclusion that impacts would be minimal.

Hazardous Waste Management

Hazardous waste management at USAKA/RTS is performed in accordance with the UES, which requires shipment of hazardous waste back to the Continental United States for treatment and/or disposal. Personnel trained in the appropriate procedures to handle potentially hazardous waste, including spill containment and cleanup, would be on standby should a mishap occur. Such personnel involved in these operations would wear appropriate protective clothing, as necessary.

The types of hazardous wastes that would potentially be generated from Falcon launches are similar to wastes already handled at USAKA/RTS. The quantity of hazardous waste that may be generated would represent a small increase over current conditions and would be collected in accordance with the Kwajalein Environmental Emergency Plan and UES. If the deluge water is determined to contain hazardous materials, it would be containerized and removed from the island. Kerosene and the helium storage trailer would be removed from the island after completion of the mission. The LOX and liquid nitrogen would be allowed to boil off (Cryogenic fluids such as LOX and liquid nitrogen boil naturally at normal temperatures, evaporating away over time.) and the plant would be secured. Collected wastes would be sent first to the point of generation accumulation point on Omelek, and on to the USAKA/RTS Hazardous Wastes Collection Point (Building 1521) on Kwajalein for eventual shipment to the continental United States and final disposition. The *de minimis* increase in the quantity of hazardous waste would not significantly impact the existing hazardous waste management and disposal system.

Post Flight Activities

Specific restoration actions and debris recovery, if necessary, would be determined on a case-by-case basis in coordination with the procedures of the Facility Services Division of Hazardous Materials. Fresh water would be used for initial cleanup of the launch pad. Fresh water would also be used to rinse the pad and stand before securing them for storage. This cleanup water would be pumped into the evaporative pond and tested for contaminants. At the conclusion of the Falcon launches, SpaceX personnel would remove all hazardous and non-hazardous material from Omelek and dispose of it in accordance with USAKA/RTS regulations. Any permanent facilities constructed in support of Falcon launches would remain and become part of the island's infrastructure.

Cumulative Impacts

Adherence to the hazardous materials and waste management systems of USAKA/RTS would preclude the potential accumulation of hazardous materials or waste. The UES establishes emergency response procedures that would aid in the evaluation and cleanup of any hazardous materials released. Falcon missile program actions are not expected to result in cumulative hazardous materials and hazardous waste impacts on USAKA/RTS. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon

launches from Omelek could be considered after the proof-of-principle launches have been completed. No other projects in the ROI have been identified that would have the potential for incremental, additive cumulative impacts to existing hazardous materials and waste management practices.

4.1.7 HEALTH AND SAFETY

An impact would be considered if it involved materials or operations that posed a potential public or occupational health hazard. The Proposed Action is not expected to substantially increase health and safety risk to either base workers and personnel or members of the public.

Site Preparation Activities

Refurbishment activities required for the Falcon Launch Vehicle Program would comply with all applicable UES and USAKA/RTS Range Safety Requirements. Missile components would initially be transported to Kwajalein. Kwajalein would also be used as the storage location for all consumable materials (e.g., solvents/cleaners, small parts, tools) that would be used during test flight pre-launch and launch operations. The primary hazard related to these storage operations would be the potential for explosion/fire of liquid fuel boosters and/or small explosive actuation devices (used in missile control and the Flight Termination System). At Kwajalein, as at all other USAKA/RTS locations, all operations involving explosives (including packaging and handling for movement) would require implementation of a written procedure, which has been approved by the USAKA/RTS Safety Office. These operations must be conducted under the supervision of an approved ordnance officer using explosive-certified personnel. All storage and handling of explosives is required to take place in facilities designed to handle explosives and which have been sited in accordance with the requirements of Kwajalein Missile Range Regulation 385-75, *Explosive Safety*. The regulation specifies the required explosive safety quantity-distances for each facility to ensure safety in the event of explosion, based upon the maximum quantity of explosive material permitted for the facility. This would serve to prevent propagation of explosions to nearby facilities where explosives are also stored.

The explosive devices and materials proposed for use as part of the Falcon flight tests would be very similar to those currently stored and used at USAKA/RTS. The total weight of explosive ordnance on the Falcon vehicle is less than 20 grams (0.7 ounce). Storage operations would not entail any specialized procedures beyond those already in use. Storage facilities (magazines) are available at Kwajalein for proper storage of all explosive materials. Missile assembly buildings, launch pads and operations buildings would be separated by distances specified in DoD and U.S. Army regulations. The types of facilities, as well as the quantity and type of propellant and other explosives stored, are used to determine the distance requirements for structure spacing.

The Marshallese individuals who have written permission from USAKA to stay temporarily on Omelek while fishing from the adjacent islands of Gellinam or Eniwetak would be asked by the USAKA/RTS Commander to evacuate the launch hazard area once the Falcon missile has been brought to the island. Two Falcon launches should not substantially affect this practice. Islands of the atoll and access to the mid-Atoll corridor are routinely closed during launch events. Once the launch has been accomplished and the associated facilities secured, the Marshallese can resume their temporary habitation.

Operational Activities

Operation of the Falcon Launch Vehicle Program would comply with all UES and USAKA/RTS Range Safety Requirements. Flight safety studies would be performed to ensure that launches would not compromise range safety requirements and that risk to personnel would be within RCC Standard 321-02 limits. Launches would not be permitted to occur without review and agreement by the Range Safety Officer. Protection circles, based on the payload, missile and launch azimuth, would be established for each launch. Access to Omelek would be limited to all but mission essential persons. Personnel would be evacuated from the island prior to launch. The flight corridor would be over the islands and open ocean. At USAKA/RTS, thrusted stages that can potentially hazard populated areas must have a flight termination system.

The first stage and fairing would impact in the open ocean. The first stage could be attached to a parachute system and recovered. The second stage would go into a degrading orbit with the payload. It will eventually reenter the atmosphere, but will burn up upon reentry and it is highly unlikely that any debris would reach the earth. When containment within the debris hazard/impact zone appears impossible, risk analysis based on established USAKA/RTS Flight Safety risk equation is done to determine if the risk to the public is within acceptable RCC Standard 321-02 criteria. Collective risk to the general public from any potentially hazardous inert debris (debris impacting the earth with a kinetic energy equal to, or greater than, 1.4 kilogram-meters [11 foot-pounds]) during a single launch would be limited to RCC Standard 321-02 criteria of $3x10^{-5}$. Individual risk from potentially hazardous inert debris would be limited to $1x10^{-7}$.

Use of existing sensors would continue in accordance with ongoing activities at USAKA/RTS. For communication link equipment, associated RF emissions are considered to be of sufficiently low power so that there is no exposure hazard. The hazards associated with the use of tracking radars at USAKA/RTS were considered in the USAKA Final Supplemental EIS (U.S. Army Space and Strategic Defense Command, 1993). The analysis considered potential program operational requirements and restrictions and USAKA-required safety procedures. It concluded that the required implementation of all operational safety procedures would preclude any potential for adverse worker or public exposure to RF radiation. Operation of these systems would not present a significant health and safety hazard.

In situations where Omelek must be evacuated, SpaceX will ensure that private marine transport capable of evacuating all personnel on island will be available for use. Personnel will turn off master power and move to Meck, where further instructions may be provided. Some emergency lighting will be provided around the dock area to facilitate and evacuation at night.

Post Flight Activities

At the conclusion of the Falcon launches, SpaceX personnel would remove all mobile equipment/assets brought to the island. Any permanent facilities constructed in support of Falcon launches would remain and become part of the island's infrastructure. No impacts to personnel or public health and safety are anticipated.

Cumulative Impacts

USAKA/RTS is a restricted access area dedicated to research, test, and training military activities. Safety standards are high at USAKA/RTS and would serve to keep any cumulative safety impacts attributable to all USAKA/RTS operations within acceptable standards to both

workers and the public. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. No other projects in the ROI have been identified that would have the potential for incremental, additive cumulative impacts to health and safety.

4.1.8 INFRASTRUCTURE

Launch activities have not been conducted at Omelek since 1996. Therefore, SpaceX would need to conduct limited refurbishment of existing buildings and bring in some additional facilities and infrastructure-related materiel in order to operate a launch facility for the Falcon Launch Vehicle Program.

The temporary increase in utility demand caused by Falcon activities is not expected to result in adverse affects to infrastructure on Kwajalein or Meck islands, since the number of personnel required would be within the range routinely handled by USAKA/RTS.

Site Preparation Activities

Transportation

Most SpaceX equipment would arrive at USAKA/RTS via commercial cargo carrier. A landing craft would be utilized to assist in the transfer of these materials (including the launch vehicle) to Omelek. Falcon program personnel would use the high-speed catamaran service from Kwajalein to Meck. SpaceX may provide private boat transportation from Meck to Omelek, which would meet local water safety regulations and Coast Guard requirements.

The two new mooring buoys added to the lagoon and located to the west of the two arms forming the Omelek harbor would be used to moor small powerboats when the landing craft is present. These powerboats would be used to transport personnel and cargo from Meck to Omelek and to evacuate personnel from Omelek prior to the launch. A new walkway on top of the riprap from the pier to the island would be added as well as other minor pier refurbishments, which would not expand the existing pier footprint. A small floating dock would be installed underneath the existing pier walkway to allow small craft to access the island and not to interfere with larger craft ability to tie up to the pier. A walkway from the dock to the riprap would be installed as well as steps connecting to the walkway being renovated on top of the riprap. No adverse impacts to the current transportation system are anticipated.

Electricity

SpaceX would provide up to two 500-kilovolt generators for power on the island, which would be supplied to the various areas required either through existing conduits below ground, or via temporary over-ground cable trays. A new double-walled diesel fuel storage tank capable of holding approximately 45,460 liters (10,000 gallons) to supply the generators would be added to the existing diesel storage area, which includes a concrete containment area, Facility 07424, currently on layaway status. The existing concrete containment structure would be inspected and upgraded if necessary. Communication hook-ups from various facilities to the communications building would be temporary: either on the ground in protected conduit, or suspended on a stand or crossed posts sunk slightly in the ground for stability. The newly constructed MAB, used for launch vehicle preparation prior to launch, would be connected to the

power systems on the island. Emergency lighting around the dock area would use the SpaceX furnished generators. No impacts to current USAKA/RTS electricity/fuel systems are anticipated.

Water

Potable water would be supplied on a weekly basis from Kwajalein and stored in two plastic 3,785-liter (1,000-gallon) reservoirs supplied by SpaceX. The reservoirs would be placed on a stand near the J.A. Jones building (relocated from Roi Namur) or the MAB. No impacts to USAKA/RTS water systems are anticipated.

Launch pad deluge water and water used to cleanup the launch pad and equipment would be obtained from a seawater pump system (the pump would require its own integral 3- to 7.5-kilowatt generator) and from freshwater supplied by SpaceX respectively. The water remaining after cleanup or after launch would either be pumped into the temporary evaporative pond or, if found to be contaminated, containerized for disposal. Water would not be discharged into the ocean. No impacts to USAKA/RTS water systems are anticipated.

Wastewater

Abandoned restroom facilities (07428) would be refurbished for use during launch operations by using a rain catchment system. The existing well system would be used for the toilets in the restroom as used previously.

The berm for the newly constructed launch pad (which would include a valved drainage system) would be used to contain the approximately 7,570-liter (2,000-gallon) deluge spray used during launch. As mentioned, this water would be supplied from the ocean by way of a temporary land-based pump.

Lines to the spray system would be temporarily placed on the ground for each launch, after which, both the pump and lines would be removed. All water would be contained within the launch pad and later tested for contaminants. The water remaining after cleanup or after launch would either be pumped into the temporary evaporative pond or, if found to be contaminated, containerized for disposal. Water would not be discharged into the ocean. No impacts to USAKA/RTS wastewater systems are anticipated.

Solid Waste

The limited amount of solid waste generated as a result of Falcon program site preparation would be collected for disposal in accordance with UES and USAKA/RTS requirements and regulations. This will ensure that special effort would be made to control food waste, thus minimizing the potential for rat and fly infestation. No impacts to USAKA/RTS solid waste levels are anticipated.

Operational Activities

A back-out crew, which would arrive and depart via boat transport, would be located at Meck for both mission abort operations and also post-flight operations. Powerboats would transport personnel from Omelek prior to launch activities.

The deluge system would begin approximately 10 seconds before launch and would continue until 30 seconds after launch. The water would be contained within the berm area of the launch pad. After the wastewater is removed, the drainage system valve would be left in the open position to allow rainwater to drain from the launch pad.

Post Flight Activities

Fresh water would be used to douse fires and for initial cleanup on the pad. Fresh water would also be used to rinse the pad and launch stand prior to securing for storage.

Approximately 35 to 50 percent of the deluge water should be reduced to steam. After each proof-of-principle flight, the remaining deluge water would be collected, containerized, and tested. Disposal of the deluge water would be accomplished by either evaporation in the temporary, bermed evaporative pond or, if found to be contaminated, the water would be pumped into drums and removed from the island. All handling and disposal of such contaminants would follow UES requirements. Any residual salt from the pond would be disposed of in the Kwajalein landfill. No impacts are expected to Omelek infrastructure from post flight activities.

SpaceX would remove all hazardous and non-hazardous waste from Omelek and dispose of it in accordance with USAKA/RTS regulations and the UES. The diesel storage container, LOX plant, and water storage containers would be secured and remain in place after the launch operation.

Cumulative Impacts

The additional demand on electrical, wastewater, solid waste, and water systems to support the small number of project-related transient personnel is expected to be within the current capacity of USAKA/RTS. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense and Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. The temporary infrastructure requirements at Omelek would be provided by ships and barges from USAKA/RTS; the refurbishment and upgrading of certain utilities structures would provide a positive impact. No cumulative impacts to area infrastructure capacity or demand are anticipated.

4.1.9 NOISE

The area of concern for the Proposed Action is noise effects on launch personnel. Noise effects on wildlife are discussed in Section 4.1.2, Biological Resources.

Site Preparation Activities

Noise from site preparation activities such as construction activities involved in the modification of existing facilities, construction of a new launch pad, and operation of equipment and generators during pre-launch activities would be minor, resulting in little to no effect on construction workers or launch personnel.

Operational Activities

Noise levels for the Falcon vehicle were modeled for the Final EA for the Falcon Launch Vehicle Program (Space Exploration Technologies Corporation, 2003) at Vandenberg Air Force Base. Table 4-3 lists the modeled noise levels for the Falcon vehicle within the 85-dB contour. These noise levels are not anticipated to impact SpaceX personnel as they would be evacuated from the island prior to the launch.

Table 4-3: Modeled Noise Levels for the Falcon Vehicle

Distance from Launch Pad kilometers (miles)	**Modeled Noise Levels** dB (dBA)
1.6 (1.0)	113.3 (78.9)
4.8 (3.0)	96.7 (62.3)
8.0 (5.0)	85.2 (50.8)

Source: Space Exploration Technologies Corporation, 2003

As Omelek has been developed as a launch support facility and has no inhabitants occupied in unrelated activities and there are no inhabited islands within 21 kilometers (13 miles), adverse impacts from launch activities are not anticipated.

Post Flight Activities

Noise generated during the removal of all mobile equipment and assets should have minimal impact to the noise environment on or off of Omelek.

Cumulative Impacts

No known sensitive noise receptors are in the vicinity; thus, no noise impacts are expected. Construction activities on Omelek related to the minor modification of existing facilities and the construction of a new launch pad would cause a short-term temporary increase in the noise levels in the immediate vicinity of the construction work. This effect would be localized, and is not anticipated to cause permanent noise level impacts. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. The sound level generated by each launch would be a short, discrete event; the potential cumulative impacts to noise from the proof-of-principle space launches would not be substantial.

4.1.10 WATER RESOURCES

This section addresses the potential impacts to water resources due to proposed activities.

Site Preparation Activities

Minor construction activities would be confined within the immediate construction area in compliance with the UES and would not impact water resources.

Operational Activities

Since the Falcon launch vehicles use LOX and kerosene propellants, the exhaust plume produced during launch would consist mainly of steam and carbon dioxide. The carbon dioxide, when mixed with the deluge water, would create carbonic acid, which would then break down into bicarbonate and hydrogen ions and create a mild acid similar to a carbonated beverage. The steam produced is anticipated to have the same pH as rainwater; that, combined with the fact that most of the steam from the exhaust plume is expected to rapidly evaporate, should produce no long-term effects. Thus, no impacts to water resources would occur as a result of launch emissions.

Although a potential impact to water resources could occur in the event of an accidental fuel spill or premature flight termination that resulted in fuel coming in contact with water resources, in the unlikely event of an accidental release of kerosene outside the containment areas, emergency response personnel would comply with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX and the Kwajalein Environmental Emergency Plan. Following these safety regulations and requirements would minimize the potential for accidental spills, as well as provide the means for mitigating or minimizing effects to water resources if an accident were to occur. The risk of accidental fuel spills during flight test activities would be considered temporary in duration.

Post Flight Activities

At the conclusion of flight activities Falcon launch vehicle personnel would remove all temporary mobile equipment/assets. Fresh water would be used to douse fires and/or for initial cleanup on the pad. Fresh water would also be used to rinse the pad and launch stand prior to securing for storage. This water would be collected and tested for contaminants. No deluge or rinse water would be discharged back into the ocean. SpaceX would remove all hazardous and non-hazardous waste from Omelek and dispose of it in accordance with USAKA/RTS regulations and the UES. Post flight activities are not expected to impact water resources on the island.

Cumulative Impacts

The small increase in the number of transient personnel at USAKA and Omelek is expected to require little or no increase in groundwater withdrawal, depending on the amount of fresh water in storage and rainfall catchment during the period of program activity. No groundwater quality degradation would be expected. Missile hardware, debris, and propellants that would fall into the ocean are expected to have only a localized, short-term effect on water quality. The proposed activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. No cumulative impacts to water resources are anticipated.

4.2 OPEN OCEAN

4.2.1 AIRSPACE—OPEN OCEAN (FLIGHT CORRIDOR)

Only the proposed flight operations have the potential for impacts to airspace use in the ocean environment. Typically, a missile would be at very high altitude passing through Flight Level (FL) 600 (approximately 18,290 meters [60,000 feet]) in just a matter of minutes after launch, and thus well above the airspace subject to the rules and regulations of the ICAO Convention.

However, the designation and activation of booster drop areas in the launch corridor could have airspace use impacts.

Controlled and Uncontrolled Airspace

The airspace in the ROI outside territorial limits lies in international airspace and, consequently, is not part of the National Airspace System. Because the area is in international airspace, the procedures of ICAO, outlined in ICAO Document 444, *Rules of the Air and Air Traffic Services* are followed. ICAO Document 444 is the equivalent air traffic control manual to FAA Handbook 7110.65, *Air Traffic Control*. The FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in the over-water ROI is managed by the Honolulu and Oakland ARTCCs.

After launch, typically the Falcon missiles would be above FL 600 within minutes of the rocket motor firing. As such, all other local flight activities would occur at sufficient distance and altitude so that the missile would be little noticed. Because the airspace in the open ocean area around Kwajalein Atoll is not heavily used by commercial aircraft, the impacts to controlled/uncontrolled airspace would be minimal. The Proposed Action would not represent a direct special use airspace impact.

To satisfy airspace safety requirements in accordance with Army Regulation 385-62 the responsible commander would coordinate activities with the Administrator, FAA, through the appropriate U.S. Army airspace representative. Provision will be made for surveillance of the affected airspace and in addition, safety regulations dictate that launch operations would be suspended when it is known or suspected that any unauthorized aircraft have entered any part of the launch hazard area or first stage and fairing drop zones until the unauthorized entrant has been removed or a thorough check of the suspected area has been performed. NOTAMs would be issued to advise avoidance of the tracking radar areas during Falcon launch and flight operations. The second stage would go into a degrading orbit with the payload.

En Route Airways and Jet Routes

Because the airspace in the open ocean area around Kwajalein Atoll is not heavily used by commercial aircraft, and has few en route airways and jet routes crossing the North Pacific, the impacts to airways and jet routes that crisscross the Ocean Area airspace use ROI are expected to be minimal. Missile launches would be conducted in compliance with DoD Directive 4540.1 that specifies procedures for conducting missile and projectile firing, namely “firing areas shall be selected so that trajectories are clear of established oceanic air routes or areas of known surface or air activity.” As stated above, before conducting a missile launch, NOTAMs would be sent in accordance with U.S. Army regulations and the responsible commander would coordinate with the Administrator, FAA, through the appropriate U.S. Army airspace representative.

In addition to the reasons cited above, no adverse impacts to the ROI’s over-water airways and jet routes are identified because of the required coordination with the FAA. The procedures for scheduling each piece of airspace are performed in accordance with letters of agreements with the controlling FAA facility and the Oakland ARTCC. Schedules are provided to the FAA facility as agreed between the agencies involved. Aircraft transiting the Open Ocean ROI on one of the low-altitude airways and/or high-altitude jet routes that would be affected by flight test activities would be notified of any necessary rerouting before departing their originating airport and would therefore be able to take on additional fuel before takeoff. Real-time airspace management involves the release of airspace to the FAA when the airspace is not in use or when

extraordinary events occur that require drastic action, such as weather requiring additional airspace.

The FAA ARTCCs are responsible for air traffic flow control or management to transition air traffic. The ARTCCs provide separation services to aircraft operating on instrument flight rules flight plans and principally during the en route phases of the flight. They also provide traffic and weather advisories to airborne aircraft. By appropriately containing hazardous military activities within the over-water Warning Areas, non-participating traffic is advised or separated accordingly, thus avoiding substantial adverse impacts to the low altitude airways and high altitude jet routes in the ROI.

Airports and Airfields

There are no airports or airfields in the Ocean Area airspace use ROI. Consequently, there would be no impacts to airports and airfields.

The Falcon launch site, launch hazard area, and the water impact and debris containment areas inside the broad ocean area east of Kwajalein Atoll would be well north of Bucholz Army Airfield and its standard instrument approach and departure procedures. Some of the desired azimuths shown on figure 2-5 could impact standard flight patterns for military aircraft coming to Kwajalein from Hawaii. SpaceX would coordinate Falcon launches with the USAKA/RTS Commander, which would include scheduling to avoid airspace conflicts. All arriving and departing aircraft are under the control of Bucholz Army Airfield Control Tower.

Cumulative Impacts

First stage and fairing impact would take place in international airspace. Operational activities would request clearance of various areas of airspace, and may cause rerouting or rescheduling of flights. However, most impacts would be in remote areas that would have little effect on air traffic. There is no airspace segregation method such as warning or restricted area to ensure that the area would be cleared of non-participating aircraft. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. Falcon launches would be short-term, discrete events, however, and using the required scheduling process for international airspace would minimize the potential for cumulative impacts.

4.2.2 BIOLOGICAL RESOURCES—OPEN OCEAN (FLIGHT CORRIDOR)

Based on prior analysis done and the effects of past launch activities, the potential impacts of activities in the open ocean related to SpaceX flights on biological resources are expected to be minimal, as discussed below.

The proposed flight operations would have no discernible or measurable effect on the ocean's overall physical and chemical properties, and thus would have no impacts to the overall marine biology of the Ocean Area ROI for USAKA/RTS. Moreover, the proposed flight operations would have no discernible effect on the biological diversity of either the pelagic or benthic marine environments. Although the proposed activities would take place in the open ocean, or pelagic zone, which is far removed from land and contains approximately 2 percent of marine species; the potential for impacts exists from the Falcon's first stage and fairing entering the ocean's surface.

Potential effects could occur from hazardous materials deposition, debris, noise levels, and sonic boom overpressures.

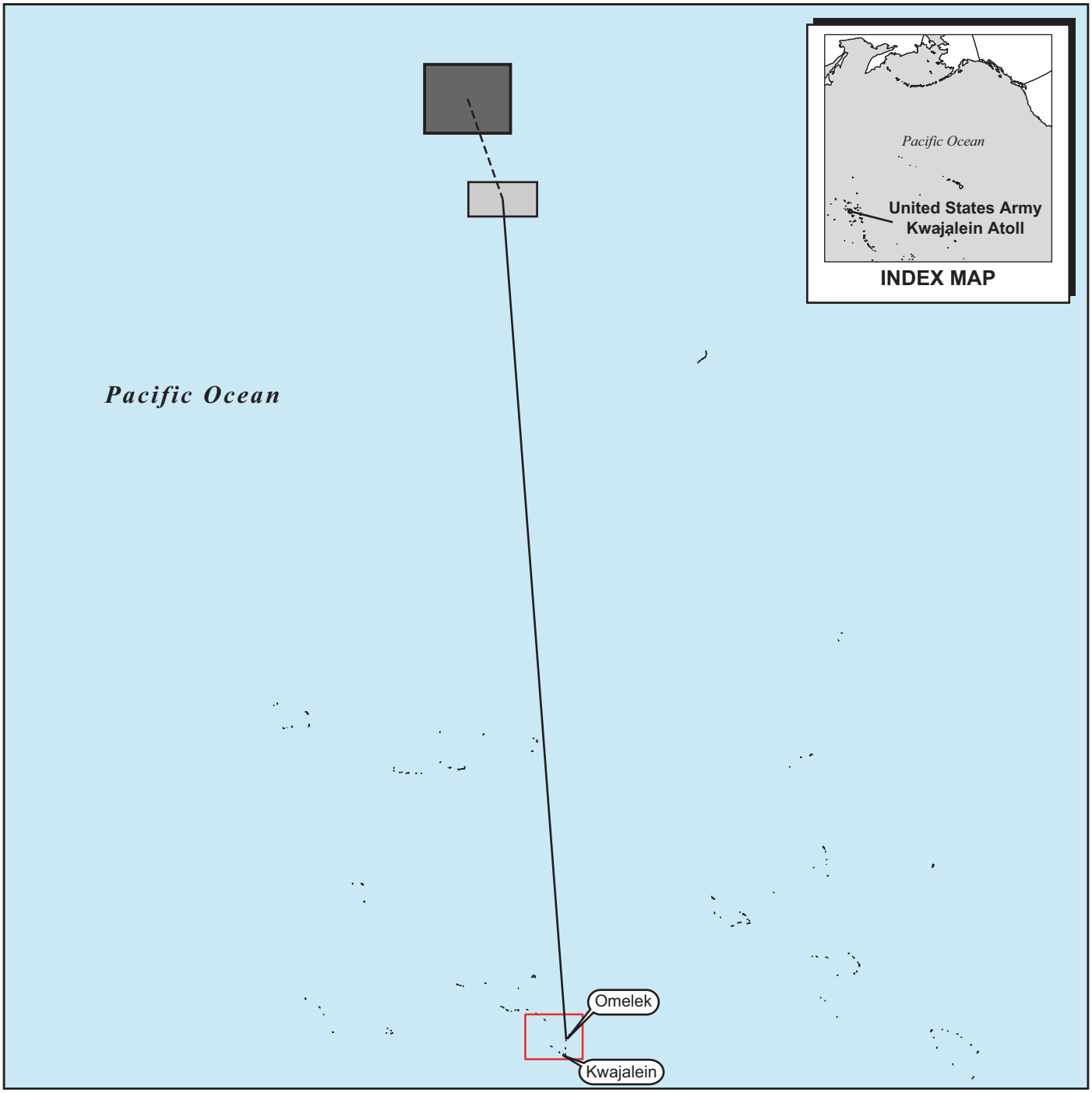
Hazardous Materials Deposition

The National Aeronautics and Space Administration conducted a thorough evaluation of the effects of missile systems that are deposited in seawater. It concluded that the release of hazardous materials aboard missiles into seawater would not be significant. Materials would be rapidly diluted and, except for the immediate vicinity of the debris, would not be found at concentrations identified as producing any adverse effects. In the event of an accidental fuel spill or premature flight termination resulting in fuel coming in contact with water resources, fuel would be rapidly buffered by the seawater thus preventing any significant adverse impacts. The Pacific Ocean depth in the vicinity of the launch area is thousands of meters (feet) deep, and any area affected by release of the propellant would be relatively small due to the size of the Falcon's motor or propellant relative to the quantity of seawater. Consequently, any impact from the fuel is expected to be minimal. In addition, an accident response team would be available to negate or minimize any adverse effects. The risk of accidental fuel spills during flight test activities would be considered minor and temporary in duration. (Federal Aviation Administration, 1996)

Debris

Debris impact and booster drops in the broad ocean area would not occur within the 322-kilometer (200-mile) limit of the Exclusive Economic Zone of affected islands (figures 4-2 and 4-3). Hydrocarbon fuels such as kerosene that reach the ocean surface would spread quickly on the surface from the effects of gravity, wind, and waves. Most of the fuel would evaporate from the ocean surface within a few hours. The remainder would disperse in the water column and degrade. Release of the liquid fuel would have little, if any, impact on water quality. (Missile Defense Agency, 2004) Analysis in the *Marine Mammal Technical Report*, prepared in support of the Point Mugu Sea Range EIS, determined that there is a very low probability that a marine mammal would be killed by falling missile boosters or debris as a result of tests at the Point Mugu Sea Range (less than 0.0149 marine mammals exposed per year). Large pieces of falling debris from missiles have the potential to strike and injure or kill marine mammals. As a general guideline, pieces of debris with an impact kinetic energy of 15 joules (11 foot-pounds) or higher are hazardous to humans (Pacific Missile Range Facility, Barking Sands, 1998). Debris impact and booster drops in the open ocean area are not expected to adversely affect marine mammal species protected by the Marine Mammal Protection Act of 1972. The probability is rather low that migratory whales or sea turtles would be within the area to be impacted by falling debris and boosters. The potential for an object or objects dropping from the air to affect marine mammals or other marine biological resources is less than 10^{-6} (1 in 1 million). The probability of a spent missile landing on a cetacean or other marine mammal is remote. (Department of the Navy, Naval Air Warfare Center Weapons Division, 2002)

This probability calculation was based on the size of the area studied and the density of the marine mammal population in that area. The analysis concluded that the effect of missile debris and intact missiles coming down in the open ocean would be negligible. The range area at Point Mugu is smaller than the USAKA/RTS range area and the density of marine mammals at Point Mugu is estimated to be larger than the density found at USAKA/RTS. It is thus reasonable to conclude that the probability of a marine mammal being injured or killed by missile or debris impact from SpaceX flights from Omelek is even more remote than at Point Mugu. (Department of the Navy, Naval Air Warfare Center Weapons Division, 2002; Pacific Missile Range Facility, Barking Sands, 1998)



EXPLANATION

- Water
- Impact area for first stage
- Impact area for fairing
- First stage flight path
- Fairing flight path

Scale

0 70 140 kilometers

NORTH

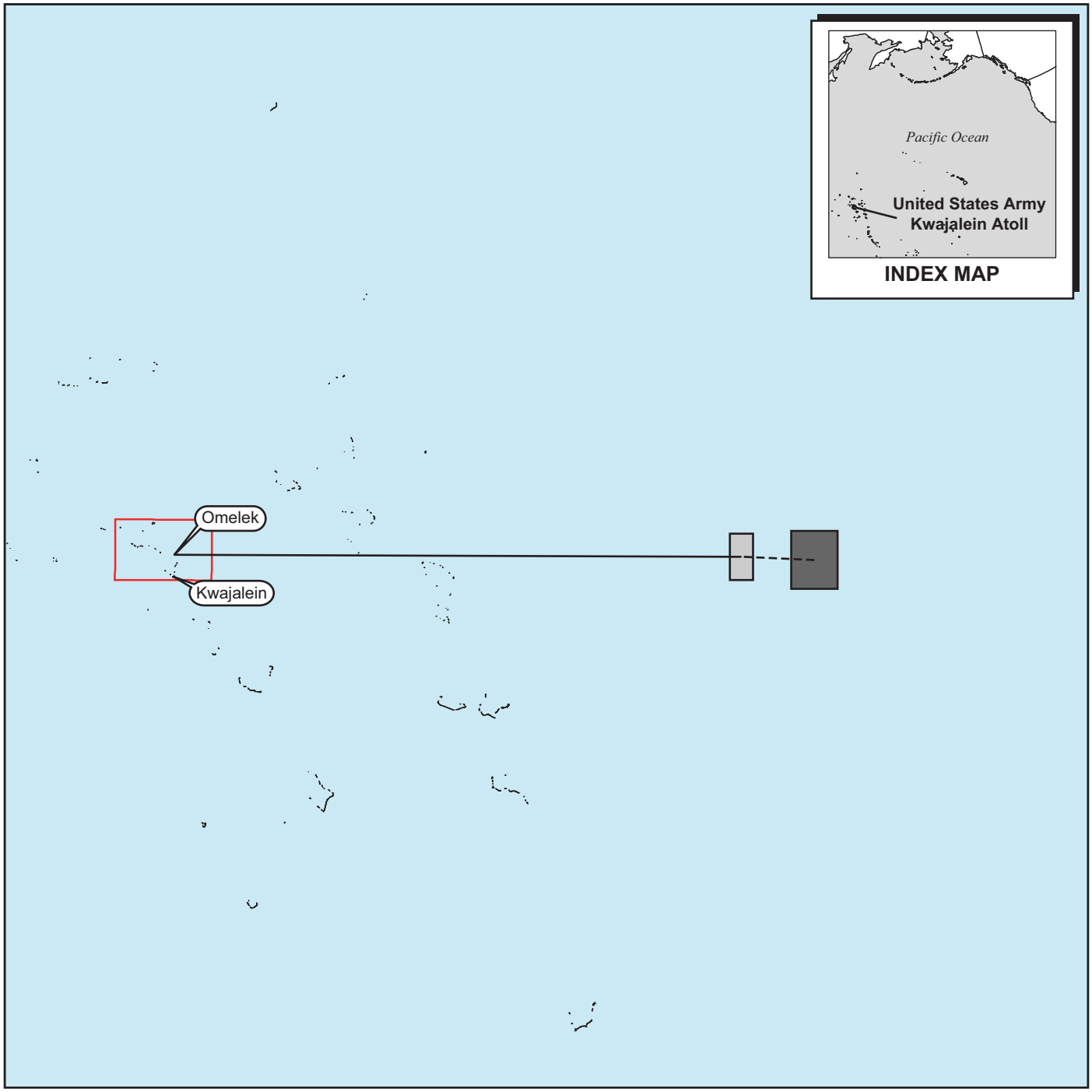
0 43.5 87 miles

10-12-04 Impact Areas

Impact Locations for First Stage and Fairing (-3 Degrees)

Kwajalein Atoll, Pacific Ocean

Figure 4-2



EXPLANATION

- Water
- Impact area for first stage
- Impact area for fairing
- First stage flight path
- Fairing flight path

Scale

0 105 210 kilometers

0 65 129 miles

NORTH

10-12-04 Impact Loc 90Deg

Impact Locations for First Stage and Fairing (90 Degrees)

Kwajalein Atoll, Pacific Ocean

Figure 4-3

The first stage may be attached to a parachute system and recovered. Entanglement of a marine mammal or sea turtle in a parachute and potential drowning would be very unlikely since the parachute would either have to land directly on an animal, or an animal would have to swim blindly into it before it is recovered or sinks to the ocean floor. The potential for a marine mammal or sea turtle to be in the same area and have physical contact with a parachute is remote.

Shock Wave Impacts

In the unlikely event of an unsuccessful flight, the Falcon launch vehicle could hit the water with speeds of 91 to 914 meters (300 to 3,000 feet) per second. It is assumed that the shock wave from its impact with the water is similar to that produced by explosives. At close ranges, injuries to internal organs and tissues would likely result. However, the taking of, or injury to, any marine mammal by direct impact or shock wave impact would be extremely remote (less than 0.0006 marine mammals exposed per year). The splashdown of the Falcon launch vehicle is planned to occur in open ocean waters thousands of meters (feet) deep at considerable distance from the nearest land. (Pacific Missile Range Facility, Barking Sands, 1998)

Sonic Boom Overpressure Impacts

In addition to the noise of the rocket engine, sonic booms are possible. A sonic boom is a sound that resembles rolling thunder, produced by a shock wave that forms at the nose of a vehicle that is traveling faster than the speed of sound. Previous sonic boom modeling performed for Falcon launch vehicles at Vandenberg Air Force Base determined that sonic boom impacts would impact the Channel Islands, approximately 64 kilometers (40 miles) from the launch site with maximum noise levels of 65 to 75 dBA. (Space Exploration Technologies Corporation, 2003)

The Falcon would propagate a unique sonic boom contour depending upon its mass, shape, velocity, and reentry angle, among other variables. The location of the possible impact point would vary depending upon the particular flight profile. It is therefore difficult to produce the specific location, extent, duration, or intensity of sonic boom impacts upon marine life. These noise levels would be of very short duration.

The noise level thresholds of impact to marine life in general, and marine mammals in particular, are currently the subject of scientific analysis. There is the possibility that underwater noise levels resulting from sonic booms could affect some marine mammals or sea turtles in the open ocean. In addition, since different species of marine mammals have varying sensitivity to different sound frequencies and may be found at different locations and depths in the ocean, it is difficult to generalize sound impacts to marine mammals from missile impacts in the broad ocean area. However, sonic boom modeling has been performed for launches of the Falcon launch vehicle from Vandenberg Air Force Base, California (Space Exploration Technologies Corporation, 2003) and compared with sonic booms from a larger missile, the Atlas IIAS. Maximum dBA sonic boom levels predicted for the Falcon were less than those of the Atlas IIAS. The modeling performed determined that sonic boom noise levels would be approximately 65 to 75 dBA 64 kilometers (40 miles) from the launch site (Space Exploration Technologies Corporation, 2003). Falcon launches from Omelek would be over the open ocean and at an altitude of approximately 8 kilometers (5 miles) when it goes supersonic.

According to analysis provided in the Navy's Point Mugu Sea Range EIS, momentary startle or alert reactions in response to a single transient sound such as a sonic boom are not considered

a significant adverse effect to whales. Humpback whales have often been observed behaving normally in the presence of strong noise pulses from sources such as distant explosions and seismic vessels. (Department of the Navy, Naval Air Warfare Center Weapons Division, 2002)

The *Final Supplemental Environmental Impact Statement for Proposed Actions at U.S. Army Kwajalein Atoll* determined that maximum short-term noise levels of less than 92 dBA would cause a nonsignificant impact in noise-sensitive areas (U.S. Army Space and Strategic Defense Command, 1993). Falcon launches from Omelek would be over the open ocean and at an altitude of approximately 8 kilometers (5 miles) when it goes supersonic. Again, these sonic booms noise levels would be similar to mild thunder. The resultant sonic boom should not adversely impact any of the surrounding islands at Kwajalein Atoll.

Prior to each launch from Omelek, sonic boom noise levels would be modeled using atmospheric conditions that would be representative of that launch. No evidence of injury, mortality, or abnormal activity to any marine mammals as a result of Atlas IIAS launches from Vandenberg Air Force Base has been observed. Based on these studies and the fact that Falcon launch vehicles would generate lower sonic boom noise levels than the Atlas IIAS, no significant impacts to marine mammals are expected.

Cumulative Impacts

No substantial impacts to the open ocean area and its wildlife have been identified from current and past missile launch activities. Prior analysis has not identified a significant potential for cumulative impacts. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. The two proposed Falcon launches would take place in the open ocean area; these would be discrete, short-term events and no adverse cumulative impacts are anticipated.

4.2.3 HEALTH AND SAFETY—OPEN OCEAN (FLIGHT CORRIDOR)

Every reasonable precaution would be taken during the planning and execution of SpaceX flight activities to prevent injury to human life or property. USAKA/RTS conducts missile flight safety, which includes overflights of the area around USAKA/RTS prior to any launch and analysis of missile performance capabilities and limitations, of hazards inherent in missile operations and destruct systems, and of the electronic characteristics of missiles and instrumentation. It also includes computation and review of trajectories and hazard area dimensions; review and approval of destruct systems proposals; and preparation of the Range Safety Approval and Range Safety Operational Plans required of all programs.

Impact zones in the open ocean area would be delineated. The location and dimensions of the impact zones would vary for each flight scenario. Figures 4-2 and 4-3 depict impact areas for the first stage and fairing that could potentially affect islands north and east of Omelek. The second stage would eventually reenter the atmosphere, but would burn up upon reentry and it is highly unlikely that any debris would reach the ocean. Impact zones for each flight would be determined by range safety personnel based on detailed launch planning and trajectory modeling. This planning and modeling would include analysis and identification of a flight corridor. Flights would be conducted when trajectory modeling verifies that flight vehicles and debris would be contained within predetermined areas, all of which would be over the open

ocean and removed from land and populated areas. Appropriate NOTMARs and NOTAMs would be issued before proceeding with a launch. Consequently, the Proposed Action would have no adverse impacts to public health and safety in the open ocean area.

Furthermore, prior warning of flight testing and training would enable commercial shipping to follow alternative routes away from test areas.

Cumulative Impacts

The Proposed Action would consist of two Falcon launches. Each of these launches would result in the impact of Falcon boosters into the open ocean, the first stage by parachute and the fairing by free-fall. The Proposed Action would result in a slight increase in flight activities in the open ocean area. As such, there could be a cumulative impact to health and safety in the open ocean area. However, the Proposed Action also requires the administration of NOTAMs and NOTMARs to warn aircraft and surface vessels of the potentially hazardous areas and allows them ample time to avoid the hazards. The Proposed Action activities would not occur at the same time as other regional programs such as Ground-Based Midcourse Defense or Minuteman III. Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed. As such, any cumulative health and safety impact in the open ocean area due to the Proposed Action would be minimal.

4.3 ENVIRONMENTAL EFFECTS OF THE NO-ACTION ALTERNATIVE

If the No-action Alternative is selected, no environmental consequences associated with the SpaceX program are anticipated. Omelek would continue in an abandoned state or it could again be considered as a missile launch facility as analyzed in prior EISs and EAs.

4.4 ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

In general, most known effects resulting from implementation of the Proposed Action would be minimized through project planning and design measures, consultation with the appropriate agency, and use of Best Management Practices. As a result, most potential adverse effects would be avoided, and those that could not be avoided would not result in a significant impact to the environment. However, mitigation measures to offset these unavoidable impacts are being considered and could include the management of habitats and exotic species at other USAKA/RTS islands such as Eniwetak.

Adverse environmental effects that cannot be avoided include removal of vegetation at the proposed new construction sites, minor short-term noise impacts to and startling of wildlife, and minor increased generation of hazardous materials at program-related sites. Pollutants would also be released to the atmosphere through generation of power, missile exhaust, and fugitive dust from construction or other ground disturbing activities. Any hazardous waste generated would be managed in compliance with DoD, and other applicable federal, state, and local regulations.

4.5 CONFLICTS WITH FEDERAL, STATE, AND LOCAL LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AREA CONCERNED

Activities at all islands within USAKA/RTS are compatible with the mission and land uses for each island. All activities would comply with federal laws and regulations, the Compact of Free Association between the RMI and the United States, and with regional and local land uses, policies, and regulation agreements. Proposed activities at all USAKA islands would comply with land use plans in the USAKA Real Property Master Plan.

4.6 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Anticipated energy requirements of the SpaceX program would be well within the energy supply capacity of all facilities. Energy requirements would be subject to any established conservation practices.

4.7 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The Proposed Action is not expected to result in the loss or impact on threatened or endangered species. No loss of cultural resources, such as archaeological or historic sites is expected. Moreover, there would be no changes in land use or preclusion of development of underground mineral resources that were not already constrained.

The amount of materials required for any program-related activities would be small. Although the proposed activities would result in some irreversible or irretrievable commitment of resources such as various construction materials, fuel, minerals, and labor, this commitment of resources is not significantly different from that necessary for many other defense research and development programs carried out over the past several years. Proposed activities would not commit natural resources in significant quantities.

4.8 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Proposed SpaceX activities would take advantage of existing facilities and infrastructure to the extent practicable. USAKA/RTS has been dedicated to military use since 1944. The use of the proposed sites to support missile and rocket launches would be consistent with this long-term practice and would be consistent with the land use plans in the USAKA Real Property Master Plan (U.S. Army Kwajalein Atoll, 2002). Therefore, the Proposed Action does not eliminate any options for future use of the environment for the locations under consideration.

4.9 NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL

Other than various structural materials and fuels, the program would require no significant natural or depletable resources.

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5.0
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5.0 REFERENCES

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7.0 AGENCIES AND INDIVIDUALS CONTACTED

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U.S. Army Kwajalein Atoll

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USAKA Directorate of Public Works
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Kwajalein, MH

U.S. Army Corps of Engineers
Fort Shafter, HI

U.S. Environmental Protection Agency
Pacific Islands Office
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U.S. Fish and Wildlife Service
Pacific Islands Office
Honolulu, Hawaii

U.S. National Oceanic and Atmospheric Administration Fisheries
Pacific Islands Area Office
Honolulu, Hawaii

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APPENDIX A
DISTRIBUTION LIST

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DISTRIBUTION LIST

Reagan Test Site
U.S. Army Kwajalein Atoll

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Defense Technical Information Center
Ft Belvoir, VA

Roi-Namur Library
U.S. Army Kwajalein Atoll

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APPENDIX B
CORRESPONDENCE

DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
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REPLY TO
ATTENTION OF

AUG 23 2004

Deputy Chief of Staff,
Engineer

Ms. Margaret Akamine
U.S. National Marine Fisheries Service
Pacific Islands Area Office
U.S. National Oceanic and
Atmospheric Administration Fisheries
1601 Kapiolani Blvd, Suite 1110
Honolulu, HI 96814-4700

Dear Ms. Akamine:

This letter is to advise you of the Falcon Launch Vehicle Program to be conducted at the U.S. Army Kwajalein Atoll/Reagan Test Site (USAKA/RTS). Two proof-of-principle launches from Omelek Islet are forecast after December 2004. The low inclination equatorial launches will have satellite payloads. After extensive evaluation, the U.S. Army Space and Missile Defense Command (USASMDC) and the USAKA Environmental Management Office (EMO) determined that a Document of Environmental Protection (DEP) was not required for this program.

In accordance with the USAKA Environmental Standards and Procedures (UES) Section 2-17.3, Document of Environmental Protection, specific criteria prompt the preparation of a DEP. The USASMDC and the USAKA EMO thoroughly reviewed all aspects of the proposed activity for possible effects on the USAKA environment. In coordination with the proponent, Space Exploration Technologies, Inc. (SpaceX), numerous project requirements were adjusted to eliminate or minimize affects on the environment. The USASMDC and USAKA EMO determined that the only environmental area that could most probably be affected and thus trigger a DEP was to endangered and threatened species, wildlife habitats, and/or migratory birds on Omelek Islet.

Per UES section 2-17.3.2(1), an evaluation by a subject matter expert was required. At the request of the USASMDC, the U.S. Fish and Wildlife Service (USFWS) conducted a field survey

of Omelek Islet. The USFWS specialist concluded that the preferred project footprint will not in all likelihood result in removal of major amounts of native vegetation, and the program will not result in direct effect on migratory birds except short-term disturbance during the project itself.

The Falcon Launch Vehicle Program is described in the enclosed summary. A DEP is not required for the two proof-of-principle launches from Omelek Islet, but may be triggered if the program is continued and requires construction or use of another islet.

As required by the National Environmental Policy Act (NEPA), USASMDC is preparing an Environmental Assessment (EA) to evaluate this activity. We will provide a copy of the final EA to all Appropriate Agencies in late October 2004.

If you have any questions or concerns, please contact Mr. Thomas Craven, USASMDC, Environmental Division, (256) 955-1533, or e-mail him at Tom.Craven@smdc.army.mil.

Sincerely,

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

Copy Furnished:
Mr. Kenneth Sims USAKA/RTS Environmental Management Office,
P.O. Box 26, SMDC-AC-K-CP, APO AP 96555-2526

Falcon Launch Vehicle Program Summary

(USAKA/RTS Omelek Space Launch Proof-of-Principle)

The U.S. Army Space and Missile Defense Command (USASMDC) is preparing an environmental assessment (EA) to analyze the impacts of two proof of principle low inclination equatorial launches of two Falcon launch vehicles with satellite payloads from the Island of Omelek (figure 1), at the U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS). The Falcon Launch Vehicle Program is a commercially available launch vehicle produced by Space Exploration Technologies, Inc. (SpaceX). No additional flights are planned at this time. If other launches are proposed after the conclusion of the two proof-of-principle launches, additional environmental documentation would be required.

SpaceX is a privately held company that is developing the Falcon as a light-launch vehicle (figure 2) to put small spacecraft into orbit with high reliability and low cost. The Falcon, a light-lift launch vehicle, is a two-stage vehicle designed to put small spacecraft into orbit with high reliability and low cost. Only the first stage would be recoverable. The Falcon uses only the liquid propellants liquid oxygen (LOX) and kerosene. No solid propellants would be used.

The Falcon Launch Vehicle Program is designed to require minimal time for vehicle assembly or payload processing on the launch pad; much of the assembly would be accomplished at the SpaceX facilities in El Segundo, California. The goal is to launch within a few days to one week of payload arrival at the launch site. This requires minimal time for processing the payload and minimal use of the launch pad. The Falcon launch vehicle would arrive at Kwajalein fully assembled and installed in its Transporter/Erector system. Payloads would be processed at Omelek also. The Falcon launch vehicle would be fueled on the pad at Omelek.

Launch activities have not been conducted at Omelek since 1996. Therefore, USAKA/RTS would need to conduct limited refurbishment of existing buildings, bring in some additional temporary buildings, and make infrastructure improvements in order to operate a launch facility for the Falcon launch vehicle. Refurbishment activities and launch of the Falcon launch vehicle would comply with all of the USAKA Environmental Standards (UES) and the RTS Range Safety Requirements.

The following sections provide descriptions of the launch vehicle, the launch operations, and alternative configurations for the launch facilities.

FALCON LAUNCH VEHICLE

The Falcon is a small, unmanned launch vehicle with a gross lift-off weight of approximately 27,216 kilograms (60,000 pounds). The Falcon uses LOX and kerosene to carry payloads into orbit. The first stage uses a turbo-pump to feed the propellant, while the second stage is pressure fed. Figure 2 shows a view of the main components of the Falcon vehicle.

First and Second Stages

The first stage consists of LOX and kerosene tanks that hold 12,708 liters (3,357 gallons) (15,587 kilograms [34,362 pounds]) of LOX and 8,245 liters (2,178 gallons) (7,159 kilograms [15,782 pounds]) of kerosene. The second stage consists of LOX and kerosene tanks with a common bulkhead, and uses helium as a pressurant. The helium flow is controlled through solenoid valves.

Thrust Termination System

In the event the Falcon launch vehicle varies from its planned trajectory, the launch vehicle would be equipped with a thrust termination system, rather than a destructive flight termination system. The thrust termination system would be activated by a command from the Range Safety Officer and would disable power to the vehicle engines. Once power is removed, there are up to six different valves that close and immediately shut off the first stage engine. On the second stage, four valves close, again shutting down the stage's engine.

Payload Description

The Falcon would carry small satellite payloads consisting of non-radioactive materials. Small amounts of ordnance, such as small explosive bolts, pressurized helium, and yet-to-be-defined batteries could be used in the payloads.

LAUNCH OPERATIONS

Pre-Launch Activities

Construction Activities

USAKA proposes to construct a missile assembly building (MAB) and a new launch pad and to make minimal modifications to the existing Omelek site, such as building refurbishment. The following facilities that currently exist on Omelek would be refurbished and used for the Falcon proof-of-principle launch operations:

- Pier and harbor
- Generator building
- Communications building

- Restrooms
- Fuel storage area

These facilities would be used for their originally intended purposes.

Two new mooring buoys (figure 3) would be added to the lagoon to the west of the two arms forming the harbor at Omelek. The buoys would be used to moor small powerboats when the landing craft is present. The buoys would be sited on sandy bottom areas using a small steel rod and shackle plate. The powerboats would be used to transport personnel and cargo from Meck Island to Omelek Island and to evacuate personnel from Omelek before the launch. The walkway on the north arm of the harbor from the pier to the island would be repaired.

Two 500-kilovolt generators would provide power on the island, which would be supplied to the various areas required either through existing conduits below ground, or via temporary over-ground cable trays. Communication hook-ups from various facilities to the communications building would be temporary: either on the ground in protected conduit or suspended on a stand or crossed posts sunk slightly in the ground for stability. Potable water would be supplied on a weekly basis from Kwajalein and stored in two plastic 3,785-liter (1,000-gallon) reservoirs. The reservoirs would be placed on a stand near the J.A. Jones building or the MAB.

A new MAB would be constructed as part of the Proposed Action. The MAB would be used for launch vehicle preparation before launch. This building would consist of a 12-meter by 30.5-meter by 0.31-meter (40-foot by 100-foot by 1-foot) concrete pad with a metal-framed "Butler" building constructed over it. The maximum height of the facility would be 8 meters (25 feet). This facility would be connected to the power systems on the island.

In addition, the J.A. Jones building would be relocated from Roi Namur to Omelek to be used as the office facility and, if necessary, a domiciliary for a few staff. A new 12-meter by 12-meter by 0.31-meter (40-foot by 40-foot by 1-foot) concrete launch pad and a truck access pad would be poured. The launch pad would include a berm to contain an accidental release of kerosene prior to launch. The berm would also be used to contain the approximately 7,570-liter (2,000-gallon) salt-water deluge spray used during launch. A valved drainage system would be included in the pad to allow rainwater drainage when the pad is not in use.

Water for the deluge system would be supplied from either the ocean or from a freshwater holding tank. If ocean water is used, a

temporary floating pump would be placed in the ocean and the lines would be run to a holding tank. The deluge system would operate as a gravity feed (perhaps with a small pump assist) to the launch pad. Lines would run from the tank to the spray system and would be placed temporarily on the ground for each launch. The deluge rate would be approximately 7,570 liters (2,000 gallons) in about 40 seconds. After the launch, the launch pad and equipment would be rinsed with about 190 - 380 liters (50 - 100 gallons) of freshwater. The rinse water would also be added to the deluge water. The pump and the lines would be removed after each launch. An evaporative pond capable of holding about 9,464 liters (2,500 gallons) of deluge and rinse water would be constructed in an area adjacent to the launch pad to allow the deluge and rinse water to evaporate.

A new diesel fuel storage tank to supply the generators would be added to the existing diesel storage area, which includes a containment area. A 1-foot deep concrete pad would be poured to support the LOX plant and storage tanks.

Launch Preparation Activities

Most SpaceX equipment including the launch vehicle would arrive at USAKA via commercial cargo carrier and would be transferred to Omelek using a landing craft. SpaceX equipment and the launch vehicle may or may not be stored on Kwajalein Island before movement to Omelek Island. The delivery to Omelek would be delayed until enough equipment arrives to fill the landing craft. Therefore, the equipment and launch vehicle system may need to be moved to storage while waiting for transport to Omelek. The launch vehicle would be stored in a physically secured area such as the Ordnance Storage Area. The equipment containers could be stored in any unsecured location.

Once the landing craft arrives at Omelek, the equipment would be off-loaded and positioned in accordance with one of the layout options described in the Options for Locations of Facilities section. Either lumber or steel would be used if the ramp angle of the landing craft requires adjustment for offloading the missile and erector.

Approximately 30 people would be involved in launch preparation activities. Up to 10 SpaceX personnel could live on Omelek in the J.A. Jones office facility if necessary. The remaining personnel would be lodged on Kwajalein and transported between the two islands on a daily basis.

The Falcon launch vehicle would be moved to the launch pad on the transporter/erector, as shown in figure 4. The transporter/erector would be approximately 267 centimeters (105 inches) wide, 21 meters (70 feet) long, and 4 meters (13 feet) tall. During erection

operations, the outriggers mounted on the trailer would be extended and lowered to the ground to raise the weight off the vehicle axles. The outriggers would be lowered hydraulically but locked mechanically to prevent backing off of the jacks. The forward end of the trailer would be chained to the concrete in two places to prevent the possibility of over-extension. After erection of the launch vehicle, four guy wires would be installed and tensioned to stabilized the erected structure and provide additional safety against surface wind loads. As long as launch operations are underway, the drainage system valve would remain closed to avoid the possibility of any contaminants reaching the surrounding soil.

Production at the LOX plant would begin once personnel arrive on Omelek. The LOX plant would also produce liquid nitrogen which would chill down the LOX loading and handling equipment as well as the LOX system on board the Falcon vehicle. LOX and liquid nitrogen would only be produced during launch preparation activities for each launch. The LOX plant would not be operated between missions. Lines would be laid over the ground from the LOX plant to the launch pad area for fueling.

Helium would be used by the Falcon vehicle system as a pressurant for the main tanks during flight. Helium would also be used as a purge during fueling operations and at engine start. The helium would be stored in a standard, over-the-road supply trailer. The trailer would be Department of Transportation certified and would have pumping equipment attached.

The trailer-mounted kerosene storage trailer would be located in a cleared area, and no concrete pad would be required. The storage trailer would be place in an open area approximately 30.5 meters (100 feet) from the launch vehicle and 30.5 meters (100 feet) from the LOX plant. Lines would be run between the loading equipment and the launch pad over the ground for fueling. Portable containment would be provided as an extra precaution against spills. Any spills would be contained and cleaned up per the procedures identified in the Kwajalein Environmental Emergency Plan.

Payload preparation activities would be conducted in parallel with most launch vehicle preparation activities. Two dress rehearsals would be included in the launch preparation schedule to allow for team training and coordination of activities between the SpaceX crew and USAKA/RTS. The launch vehicle would be erected approximately 4 days before launch, and this would be the first opportunity to test transmissions from the launch vehicle and reception at USAKA/RTS stations.

The kerosene and the helium would be loaded into the Falcon launch vehicle on the day before launch. The thrust vector control would also be checked at this time.

Launch Activities

Day of Launch

On the day of launch, the activities would include the following:

- Final launch pad preparations completed, including removal of all loose items, such as tarpaulins and tool boxes
- Erector lowered and removed
- Final volume of helium loaded
- LOX loaded
- Island evacuated

The Falcon launch countdown is a 6-hour procedure that would be submitted for USAKA/RTS review and approval before implementation.

The deluge system would begin approximately 10 seconds before launch and would continue for 30 seconds through launch. The water would be contained within the berm area of the launch pad.

Launch Trajectory

The proposed launch site can accommodate safe trajectories for almost any orbital inclination. Figure 5 shows desired launch azimuths. The first Falcon mission from Omelek would be a sun-synchronous orbit (satellite passes over the same part of the earth at about the same local sun time each day) at an 800-kilometer (497-mile) altitude with a launch azimuth of -3 degrees (true). The second mission would be for a 90-degree azimuth to an orbit of 685 kilometers (425 miles).

These two trajectories represent the most common azimuths expected to be used from USAKA/RTS. Some limited maneuvering would be possible if necessary to avoid sensitive areas.

The design of the Falcon retains the option to recover the spent first stage by the use of a parachute attached to the front end of the first stage at locations as indicated in tables 1 and 2. A salvage ship would locate the floating first stage by homing in on a transponder that signals the location. There is a potential for approximately 30.3 liters (8 gallons) of LOX and 19 liters (5 gallons) of kerosene to remain in the expended first stage. The first stage would be recovered by USAKA/RTS personnel and equipment and returned to Kwajalein Island. SpaceX would then transport it to

their facilities in El Segundo, California, for reconditioning and reuse.

Table 1: Impact Locations for First Stage and Fairing (Equatorial Launch)

	Latitude	Longitude	Impact Ellipse Estimate
First Stage	18.003 degrees	167.043 degrees	64 kilometers x 32 kilometers (40 miles x 20 miles)
Fairing	18.782 degrees	166.694 degrees	80 kilometers x 64 kilometers (50 miles x 40 miles)

Table 2: Impact Locations for First Stage and Fairing (90 Degrees)

	Latitude	Longitude	Impact Ellipse Estimate
First Stage	8.9155 degrees	176.814 degrees	64 kilometers x 32 kilometers (40 miles x 20 miles)
Fairing	8.899 degrees	177.589 degrees	80 kilometers x 64 kilometers (50 miles x 40 miles)

The payload fairing would drop at a location downrange into the Pacific Ocean, as indicated in table 2-1. The second stage would not be recovered. The majority of the second stage would burn up during atmospheric reentry and only small amounts of debris would impact into the ocean.

Post-Launch Activities

A back-out crew would be located at Meck Island for both mission abort operations and post-flight operations. This crew would arrive and depart Meck Island by boat and would be in communication with the launch organization at Meck Island. After launch and approval by ground safety, the crew would approach Omelek and begin post-launch procedures.

SpaceX personnel would clean up the launch site. Salt water would be used to douse fires if necessary and for initial cleanup on the pad. Fresh water would be used to rinse the pad and launch stand before securing for storage. This water would be placed in the evaporative pond and allowed to evaporate. After each proof-of-

principle flight test, the deluge water would be collected, containerized, and tested. If contaminants are found, the wastewater would be properly handled and disposed of according to UES requirements. If no contaminants are found, the water could be placed in a temporary evaporative pond. The residual salt would be disposed of in the Kwajalein landfill. After the wastewater is removed, the drainage system valve would be left in the open position to allow rainwater to drain from the launch pad.

SpaceX would remove all hazardous and non-hazardous waste from Omelek and dispose of it in accordance with USAKA/RTS regulations and the UES. All equipment except for the LOX plant, diesel storage container, SpaceX office facility, and the water storage containers would be removed after the launch operation. Facilities at Omelek would be cleaned and prepared for storage within approximately 7 days.

OPTIONS FOR LOCATIONS OF FACILITIES

There are four options for the locations of the facilities to be used at Omelek Island. They are described below.

Option 1

Option 1 (figure 6) involves the construction of a new launch pad, the LOX plant, and fuel storage facilities on the east side of the island. The new MAB would be sited on the southwest quadrant of the island along with the J.A. Jones building. The launch control van would be placed on the west side of the island.

Option 2

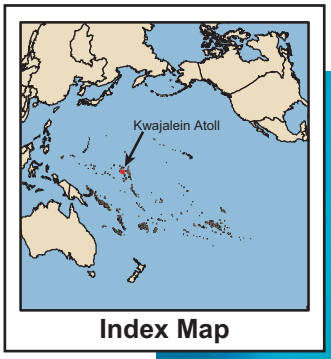
In Option 2 (figure 7) the launch pad and a new slab to facilitate connecting the erector to the launcher would be constructed on the northern part of the island. The LOX plant would be built west of the slab and the fuel storage facility would be built on the east side of the slab. The MAB and the J.A. Jones building would all be placed in the southwest quadrant of the island, as in Option 1. The launch control van would be placed between the MAB and the J.A. Jones building.

Option 3

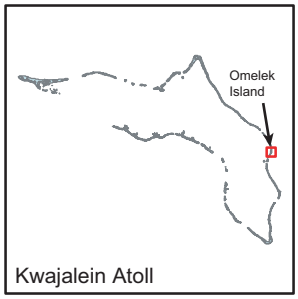
In Option 3 (figure 8) the launch pad and slab, the LOX plant, and the fuel storage facility would be built in the same sites as described in Option 2. The MAB would be built on the east side of the island. The J.A. Jones building would be placed in the southeast quadrant of the island. The launch control van would be placed in the southwest quadrant of the island in the same location used in Option 2.

Option 4 (Preferred Alternative)

In Option 4 (figure 9) the location of the launch pad, the LOX plant, and the fuel storage facility would be the same as described in Option 1. The MAB would also be at the same site used for Option 1. The J.A. Jones building and the launch control van would be placed on the west side of the island.



Index Map



Index Map

EXPLANATION

Omelek Island

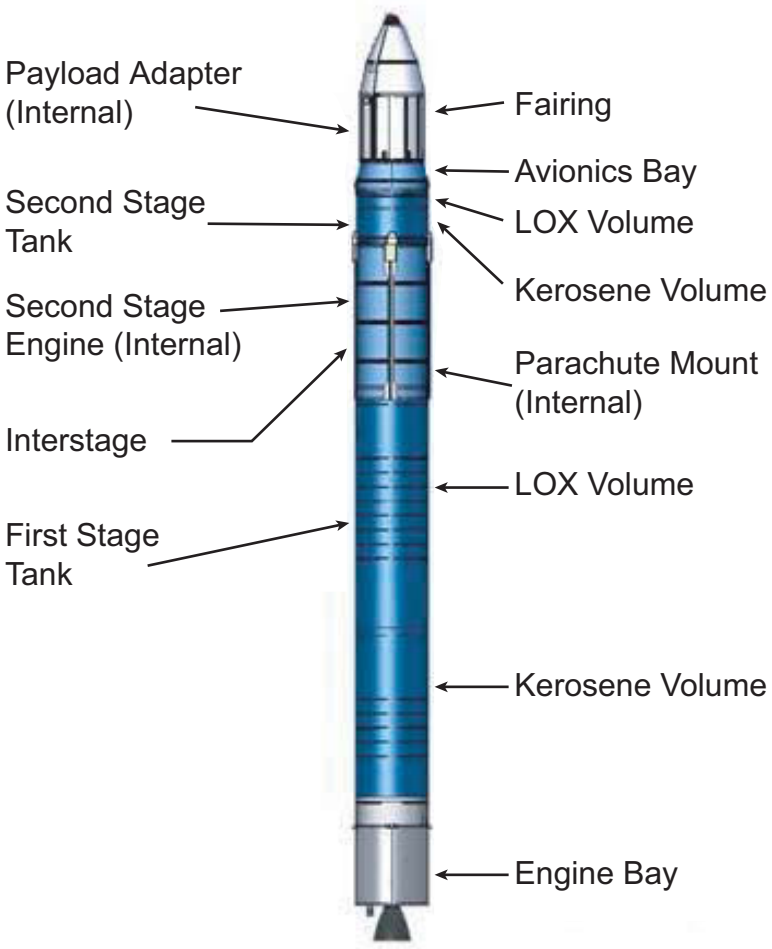
Omelek, Kwajalein Atoll

Unknown Scale

NORTH

Figure 1

07-15-04 Omelek Island

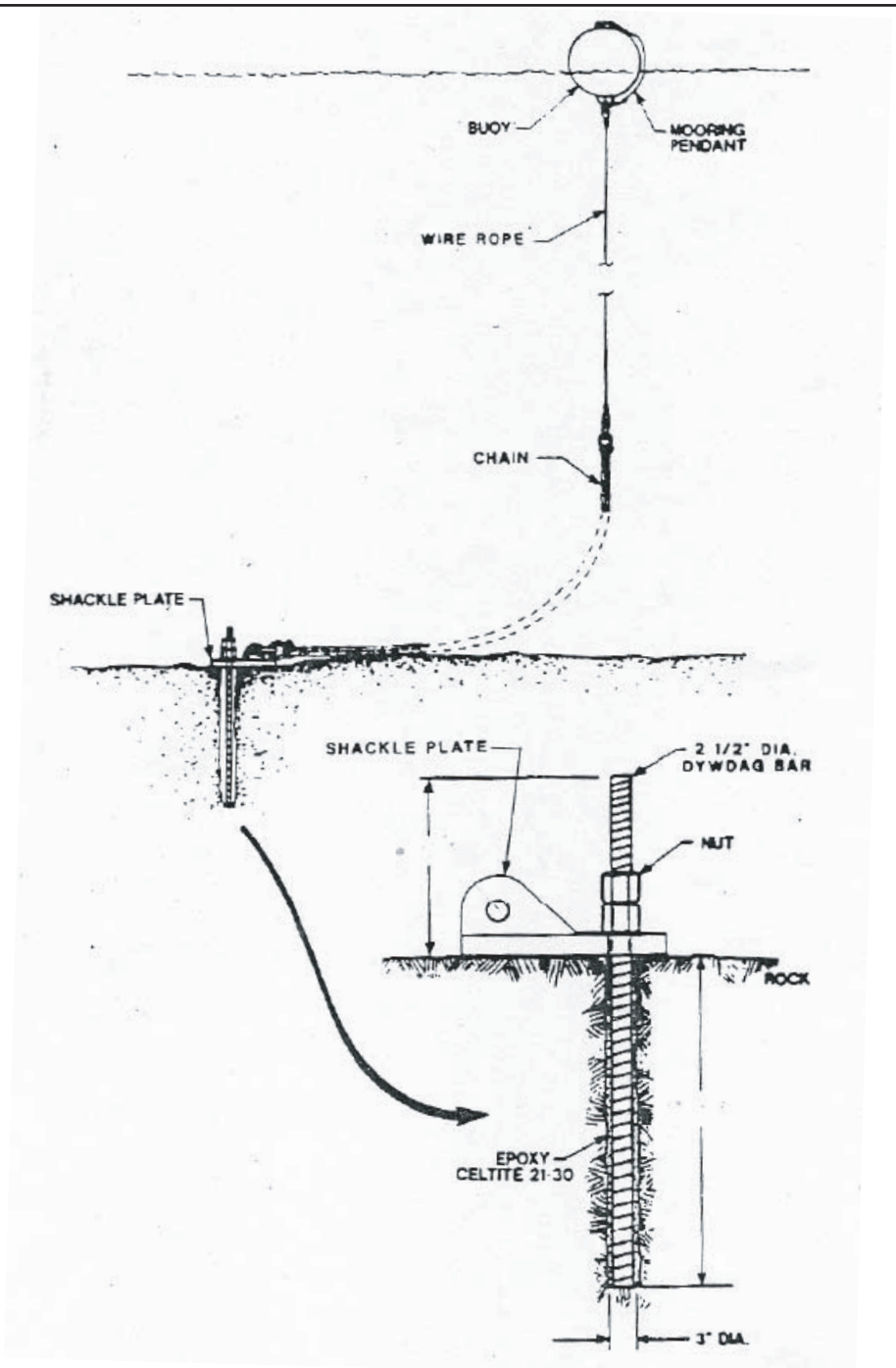


EXPLANATION

Falcon Launch Vehicle Main Components

Not to Scale

Figure 2



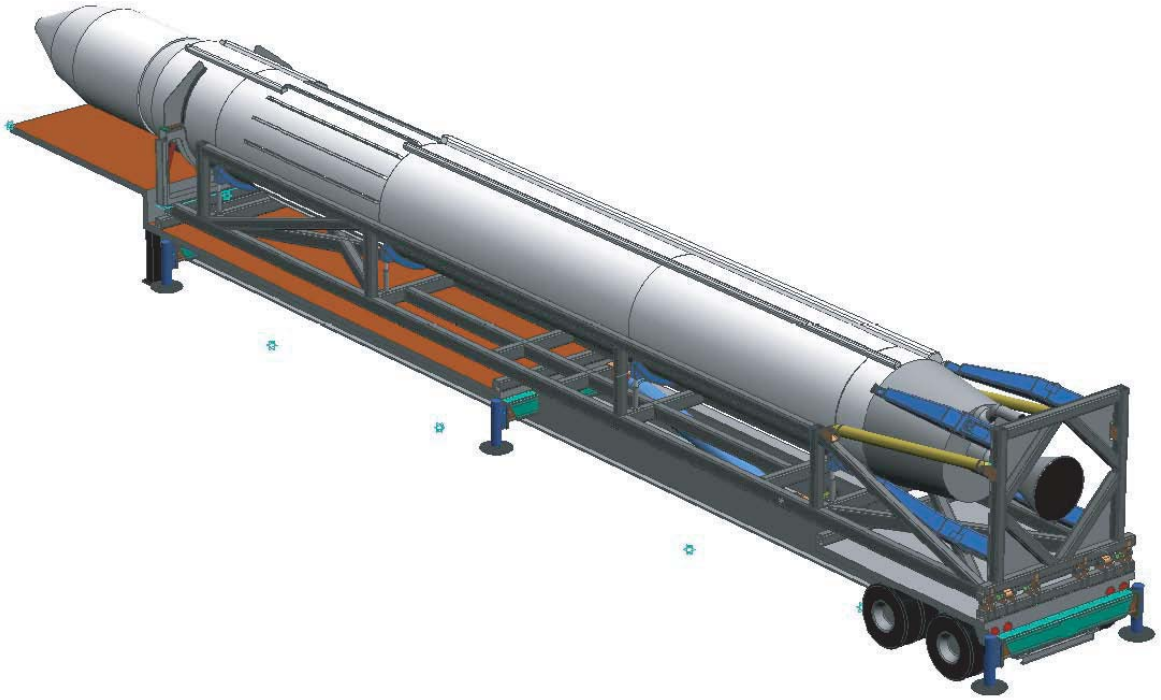
EXPLANATION

Mooring Buoy

Not to Scale

Figure 3

08-13-04 Mooring Buoy

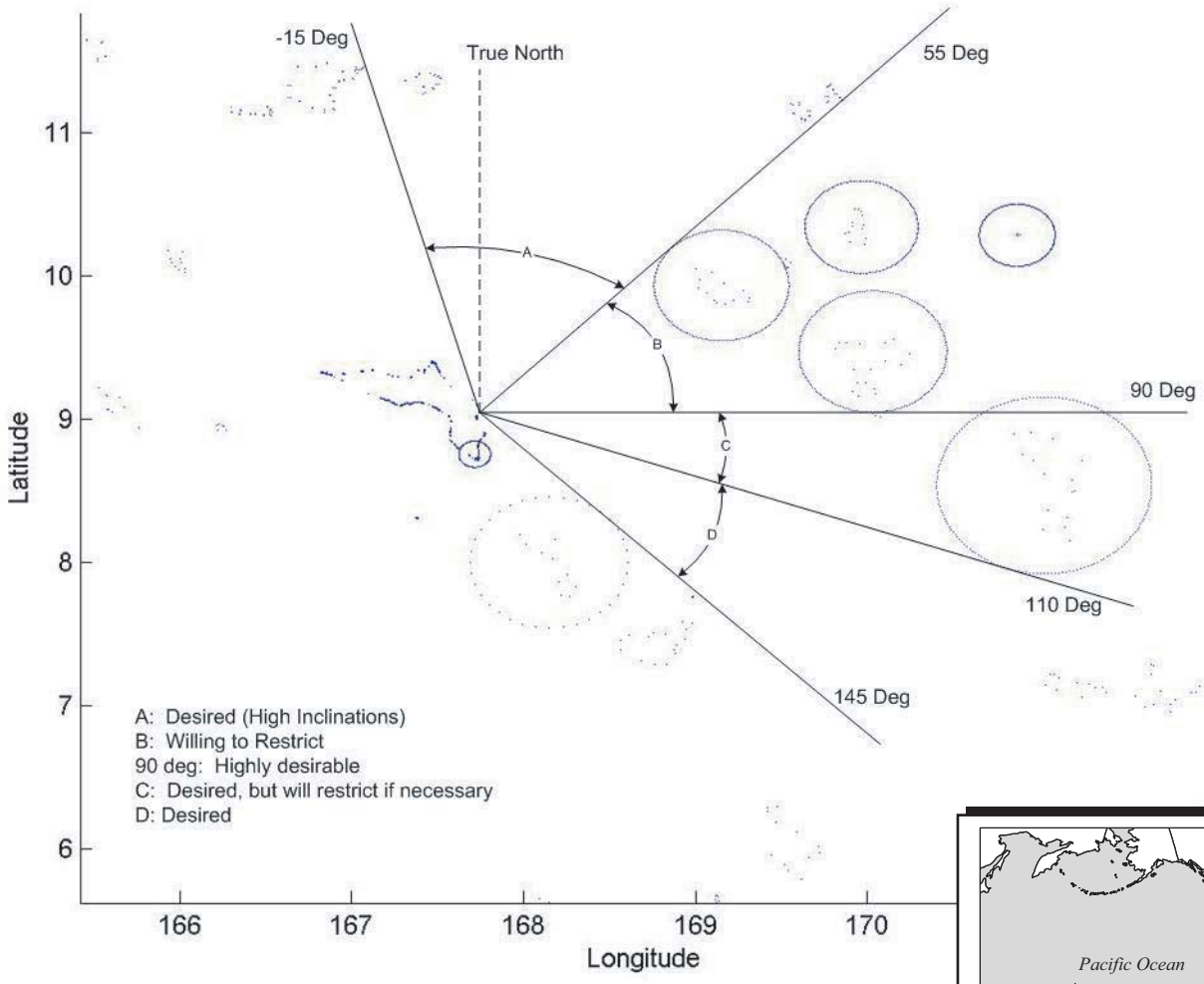


EXPLANATION

Falcon Transporter/Erector

Not to Scale

Figure 4



INDEX MAP

EXPLANATION

◯ Protection circles for inhabited islands

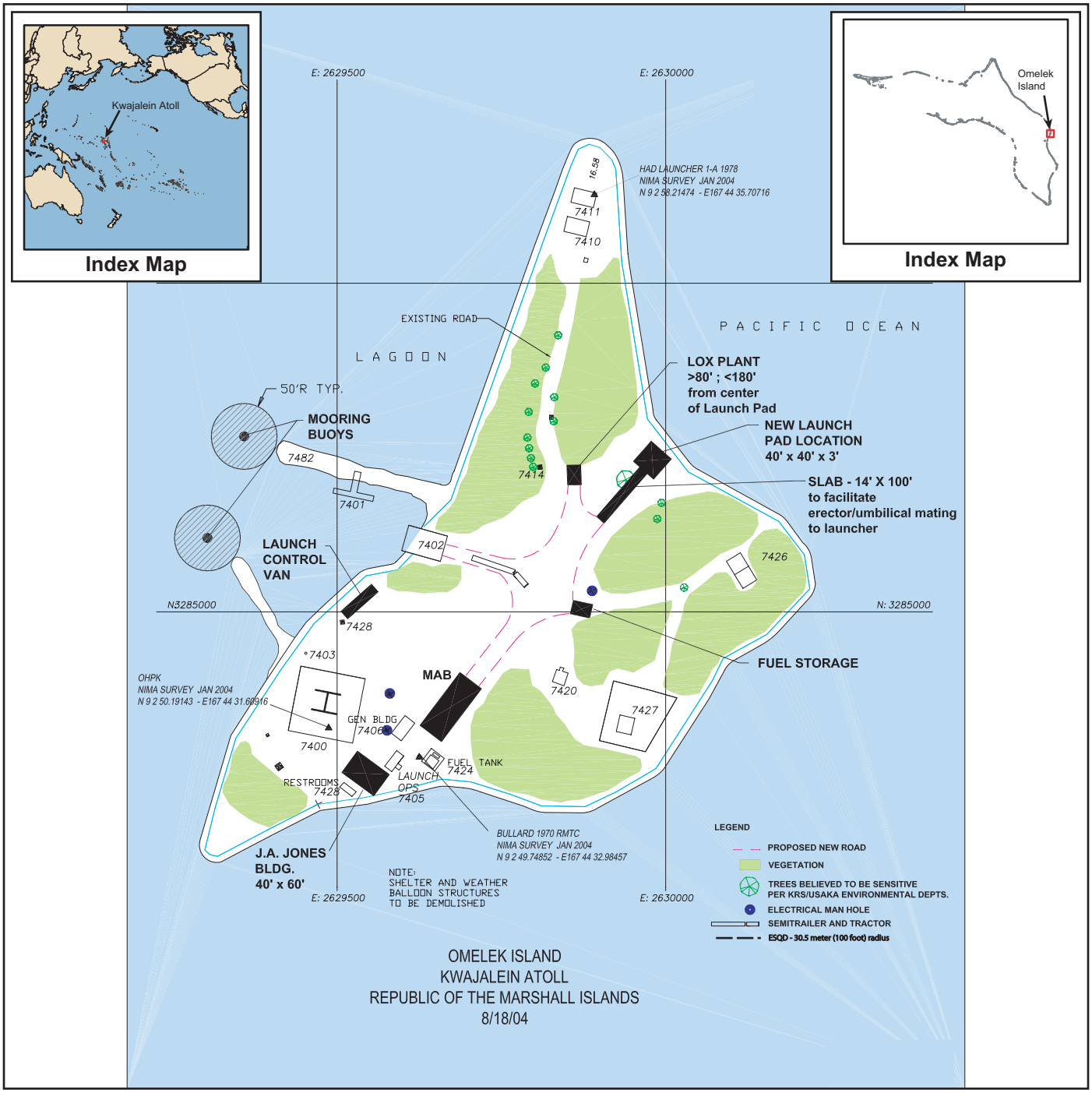
Potential Launch Azimuths From Omelek

Kwajalein Atoll, Pacific Ocean

Not to Scale

Figure 5

08-13-04 Launch AZ Omelek



EXPLANATION

Option 1

NORTH

Scale

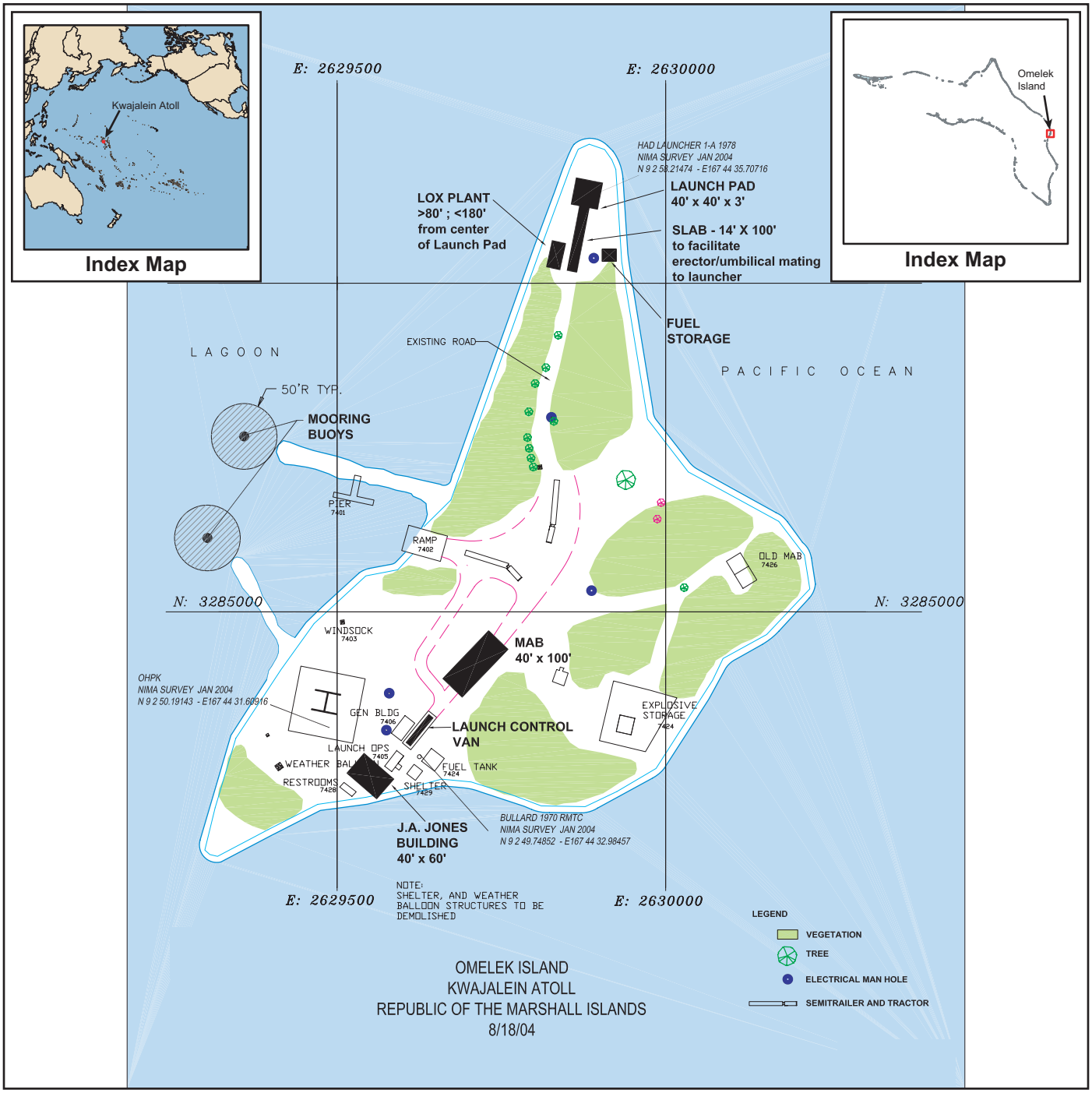
0 34.7 69.4 meters

0 113.8 227.7 feet

08-13-04 Option 1

Omelek, Kwajalein Atoll

Figure 6



EXPLANATION

Option 2

Scale

NORTH

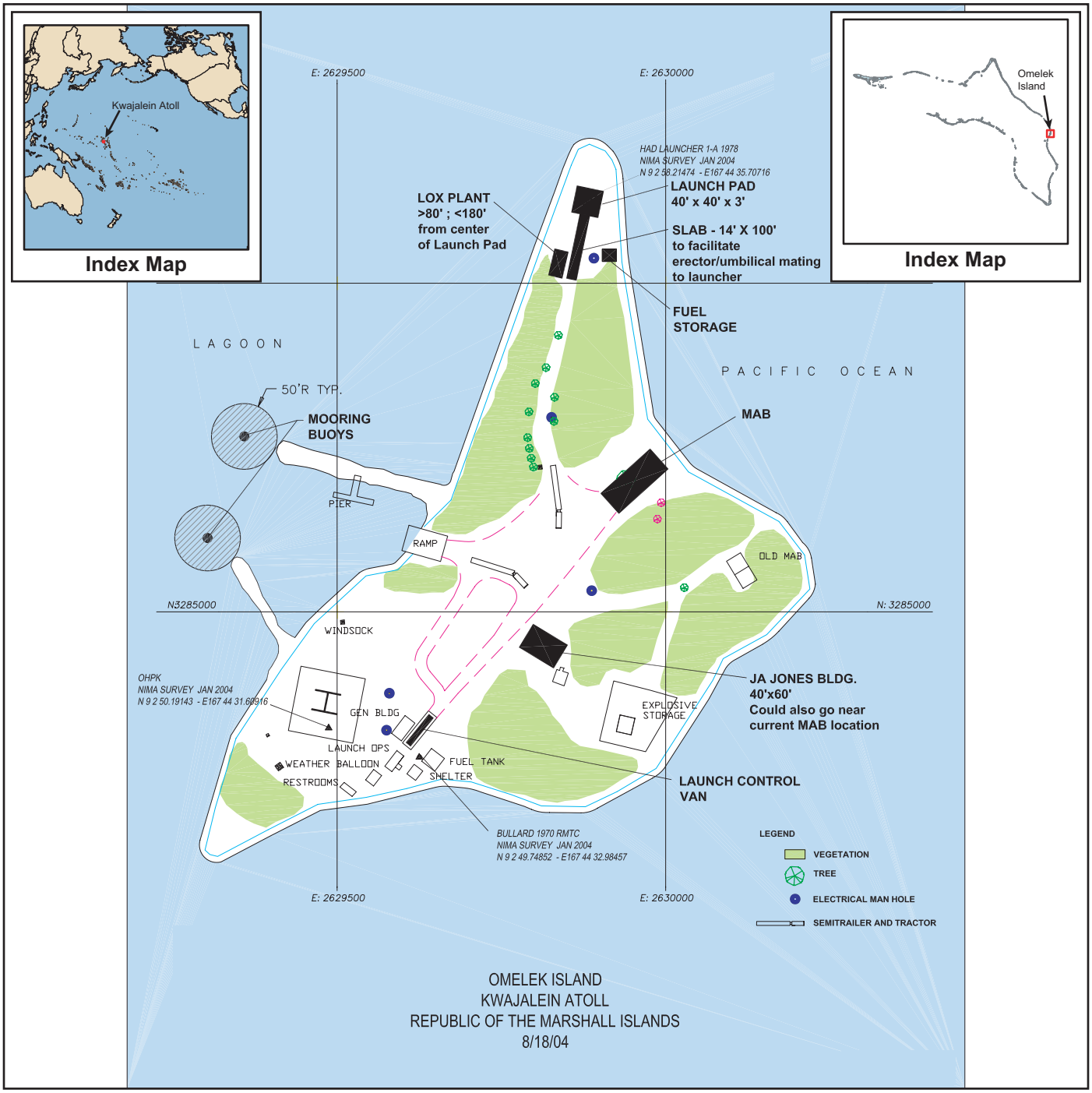
0 34.7 69.4 meters

0 113.8 227.7 feet

08-13-04 Option 2

Omelek, Kwajalein Atoll

Figure 7



EXPLANATION

Option 3

NORTH

Scale

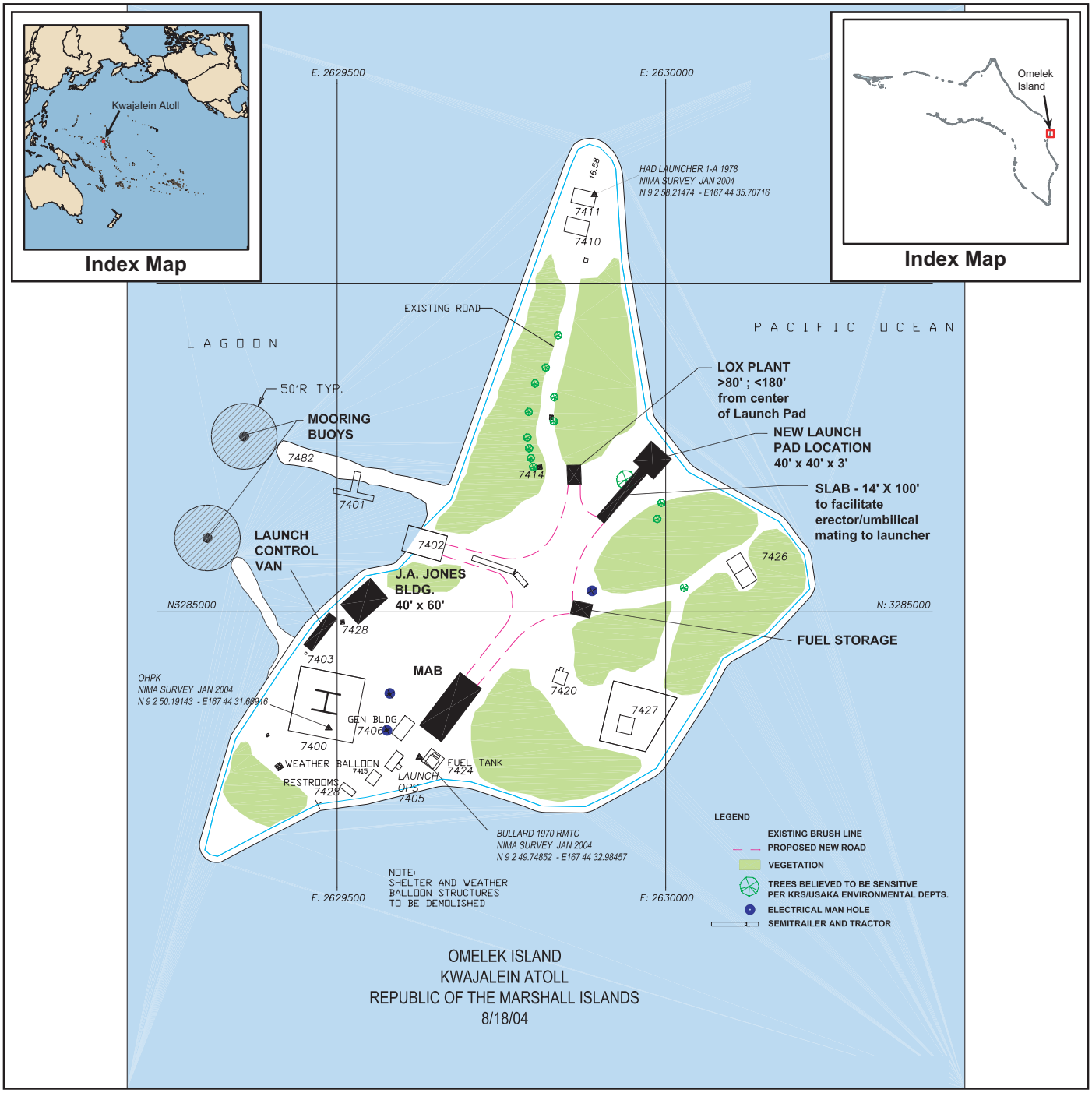
0 34.7 69.4 meters

0 113.8 227.7 feet

08-13-04 Option 3

Omelek, Kwajalein Atoll

Figure 8



EXPLANATION

Option 4

Scale

0 34.7 69.4 meters

NORTH 0 113.8 227.7 feet

08-13-04 Option 4

Omelek, Kwajalein Atoll

Figure 9

DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

AUG 23 2004

Deputy Chief of Staff,
Engineer

Mr. John Bungitak
Republic of the Marshall Islands
Environmental Protection Authority (RMIEPA)
General Manager
P.O. Box 1322
Majuro, MH 96960-1322

Dear Mr. Bungitak:

This letter is to advise you of the Falcon Launch Vehicle Program to be conducted at the U.S. Army Kwajalein Atoll/Reagan Test Site (USAKA/RTS). Two proof-of-principle launches from Omelek Islet are forecast after December 2004. The low inclination equatorial launches will have satellite payloads. After extensive evaluation, the U.S. Army Space and Missile Defense Command (USASMDC) and the USAKA Environmental Management Office (EMO) determined that a Document of Environmental Protection (DEP) was not required for this program.

In accordance with the USAKA Environmental Standards and Procedures (UES) Section 2-17.3, Document of Environmental Protection, specific criteria prompt the preparation of a DEP. The USASMDC and the USAKA EMO thoroughly reviewed all aspects of the proposed activity for possible effects on the USAKA environment. In coordination with the proponent, Space Exploration Technologies, Inc. (SpaceX), numerous project requirements were adjusted to eliminate or minimize affects on the environment. The USASMDC and USAKA EMO determined that the only environmental area that could most probably be affected and thus trigger a DEP was to endangered and threatened species, wildlife habitats, and/or migratory birds on Omelek Islet.

Per UES section 2-17.3.2(1), an evaluation by a subject matter expert was required. At the request of the USASMDC, the U.S. Fish and Wildlife Service (USFWS) conducted a field survey

of Omelek Islet. The USFWS specialist concluded that the preferred project footprint will not in all likelihood result in removal of major amounts of native vegetation, and the program will not result in direct effect on migratory birds except short-term disturbance during the project itself.

The Falcon Launch Vehicle Program is described in the enclosed summary. A DEP is not required for the two proof-of-principle launches from Omelek Islet, but may be triggered if the program is continued and requires construction or use of another islet.

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If you have any questions or concerns, please contact Mr. Thomas Craven, USASMDC, Environmental Division, (256) 955-1533, or e-mail him at Tom.Craven@smdc.army.mil.

Sincerely,

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

Copy Furnished:
Mr. Kenneth Sims USAKA/RTS Environmental Management Office,
P.O. Box 26, SMDC-AC-K-CP, APO AP 96555-2526

DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

AUG 23 2004

Deputy Chief of Staff,
Engineer

Mr. John McCarroll
United States Environmental
Protection Agency, Region IX
Pacific Islands Office
75 Hawthorne Street (CMD-6)
San Francisco, CA 94105

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Engineer

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POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

AUG 23 2004

Deputy Chief of Staff,
Engineer

Mr. Michael Molina
U.S. Fish and Wildlife Service (USFWS)
Pacific Islands Fish and Wildlife Office
P.O. Box 50088
Honolulu, HI 96850

Dear Mr. Molina:

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Engineer

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POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

AUG 23 2004

Deputy Chief of Staff,
Engineer

Ms. Helene Y. Takemoto
U.S. Army Engineer District, Honolulu
CEPOH-PP-E, Building 230, Room 306
Ft. Shafter, HI 96858-5440

Dear Ms. Takemoto:

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Sincerely,

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

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P.O. Box 26, SMDC-AC-K-CP, APO AP 96555-2526

DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO ATTENTION OF

SEP 01 2004

Deputy Chief of Staff,
Engineer

Ms. Margaret Akamine
U.S. National Marine Fisheries Service
Pacific Islands Area Office
U.S. National Oceanic and Atmospheric Administration
Fisheries
1601 Kapiolani Blvd, Suite 1110
Honolulu, HI 96814-4700

Dear Ms. Akamine:

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If you have any questions or concerns, please contact Mr. Thomas Craven, USASMDC, Environmental Division, (256) 955-1533, fax (256) 955-5074 or e-mail him at tom.craven@smdc.army.mil.

Sincerely,

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

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Mr. Kenneth Sims USAKA/RTS Environmental Management Office, P.O. Box 26, SMDC-AC-K-CP, APO AP 96555-2526

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U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

SEP 01 2004

Deputy Chief of Staff,
Engineer

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Republic of the Marshall Islands
Environmental Protection Authority (RMIEPA)
General Manager
P.O. Box 1322
Majuro, MH 96960-1322

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Sincerely,

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

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DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

SEP 01 2004

Deputy Chief of Staff,
Engineer

Honorable Lenest Lanki
Secretary of Internal Affairs and
RMI Historic Preservation Officer
P.O. Box 1011
Majuro, MH 96960

Dear Mr Lanki:

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Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

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U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

SEP 01 2004

Deputy Chief of Staff,
Engineer

Mr. John McCarroll
United States Environmental
Protection Agency, Region IX
Pacific Islands Office
75 Hawthorne Street (CMD-6)
San Francisco, CA 94105

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Sincerely,

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Colonel, U.S. Army
Deputy Chief of Staff,
Engineer

Enclosure

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POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

SEP 01 2004

Deputy Chief of Staff,
Engineer

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U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
P.O. Box 50088
Honolulu, HI 96850

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HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF

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Enclosure

Copy Furnished:
Mr. Kenneth Sims USAKA/RTS Environmental Management Office, P.O. Box 26, SMDC-AC-K-CP, APO AP 96555-2526

"Craven, Tom M Mr USASMDC" wrote:

To the U.S. Army Kwajalein Atoll Environmental Standards Appropriate Agencies,

The US Army Space and Missile Defense Command (SMDC), in accordance with the USAKA Environmental Standards and the National Environmental Policy Act, has prepared a Coordinating Draft Proof of Principle Space Launches from Omelek Environmental Assessment (CDEA). A copy of the CDEA has been expressed mailed to each of you. If you would like immediate access to the CDEA, it and an electronic version of the comment form are currently available via the internet at http://www.smdcen.us/eaeisdoc/spacex.asp <http://www.smdcen.us/eaeisdoc/spacex.asp> . The login is spacexuser and the password is SpaceX4. Both the login and password are case sensitive.

Please provide your comments on this EA by 1 October 2004 using the comment form. You can e-mail your comments to tom.craven@smdc.army.mil <mailto:tom.craven@smdc.army.mil> .

This EA is examining the potential environmental effects of using the Falcon Launch Vehicle to put small payloads into low earth orbit fromOmelekIsland. The proposed activity includes two proof of principle launches of the Falcon launch vehicle from OmelekIsland. In a letter dated 23 August 2004, SMDC provided you with a summary of the program and proposed activities and with the determination that a Document of Environmental Protection would not be required for this proposed activity.

If you have any questions or concerns, please contact me, (256) 955-1533, fax (256) 955-5074 or e-mail at tom.craven@smdc.army.mil <mailto:tom.craven@smdc.army.mil> .

Tom Craven

Environmental Division

Deputy Chief of Staff, Engineer

US Army Space and Missile Defense Command

Hi Tom and Ken,

I'm very sorry, but I'm not available until after next Tuesday. If you can send me a note describing the complications and question you may have, maybe I can jot a brief response between now and next week.

Thanks,
Holly

"Craven, Tom M

Mr USASMDC" To: "'holly_freifeld@r1.fws.gov'" <holly_freifeld@r1.fws.gov>

<Tom.Craven@us.a cc: "Sims, Kenneth Mr. USASMDCK" <Kenneth.Sims@usaka.smdc.army.mil>

rmy.mil> Subject: Omelek Proposed Mitigation/Recommendations

08/26/2004 11:43

AM

Holly,
Ken Sims and I would like to talk to you about the mitigations you recommended for the Omelek launch project. Would you be available tomorrow around 9:00 am your time to talk to us about the recommendations. We are trying to finalize the Coordinating Draft EA and I want to incorporate the recommendations as much as possible, but there are some complications we would like to talk to you about.

Let me know if that time tomorrow is good for you.

Thanks
Tom

CC: "Sims, Kenneth Mr. USASMDCK" <Kenneth.Sims@usaka.army.mil>

-----Original Message-----
From: Takemoto, Helene Y POH [mailto:Helene.Y.Takemoto@poh01.usace.army.mil]

Sent: Tuesday, September 28, 2004 2:42 PM
To: 'Craven, Tom M Mr USASMDC'
Subject: Coordinating Draft Proof of Principle Space Launches from Omelek Environmental Assessment

Tom,

I have reviewed the EA on the above subject and have no comments to offer.

Helene

-----Original Message-----
From: Elizabeth Harding [mailto:eharding@mindspring.com]
Sent: Tuesday, September 28, 2004 5:56 PM
To: Craven, Tom M Mr USASMDC
Cc: John Bungitak
Subject: SPACEX - RMIEPA

Tom,

John Bungitak wishes me to convey to you that the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) has no comment on the SPACE X Environmental Assessment at this time. Thank you for your communications to John regarding this project.

Sincerely,

Elizabeth

Elizabeth Harding & Associates, P.C.
7744 S. Jackson Circle
Centennial, CO 80122

Phone/Fax: (303) 771-4096

-----Original Message-----
From: holly_freifeld@r1.fws.gov [mailto:holly_freifeld@r1.fws.gov]
Sent: Thursday, September 30, 2004 5:09 PM
To: Craven, Tom M Mr USASMDC
Cc: 'kevin_b_foster@fws.gov'; 'michael_molina@fws.gov'
Subject: Re: FW: Omelek Proposed Mitigation/Recommendations

Hi Tom,

Sorry about that.
Please scroll down and see my responses following your responses - mine are set off in ***triple asterisks.*** Nope, I had no questions/issues, other than being reluctant to withdraw anything that I put in my report.

Thanks,
Holly

"Craven, Tom M Mr USASMDC"
To: "'holly_freifeld@r1.fws.gov'" <holly_freifeld@r1.fws.gov>

<Tom.Craven@us.army.mil cc: "'kevin_b_foster@fws.gov'"
<kevin_b_foster@fws.gov" 'michael_molina@fws.gov'" <michael_molina@fws.gov>
Subject: FW: Omelek Proposed
Mitigation/Recommendations
09/24/2004 06:17 AM

Holly,
I wanted to touch base with you on a couple of points.

First, I didn't hear back from you on the email below that showed how we were trying to incorporate your site visit report and recommendations. Did you have any questions or issues with it? If so, please let me know and I would be glad to discuss them with you.

Secondly, it's about 3 weeks into the review period for the SPACEX EA (aka Proof-of-Principle Space Launches from Omelek Island EA). At about this point I like to contact the agencies and see how the EA review is progressing. I also like to see if there are any questions or issues that you have identified that you might like to discuss. I talked really briefly with Kevin yesterday

and he said you guys were reviewing the EA and were on course for the due date. If you folks have any issues on the EA let me know.

Mahalo
Tom

-----Original Message-----
From: Craven, Tom M Mr USASMDC
Sent: Friday, August 27, 2004 2:39 PM
To: 'holly_freifeld@r1.fws.gov'
Cc: Sims, Kenneth Mr. USASMDCK; Michael_Molina@r1.fws.gov
Subject: RE: Omelek Proposed Mitigation/Recommendations

Holly,

Holly,

Not a problem. Let me see if we can resolve how we incorporate these into the EA here. Shown below are your recommendations and our proposed response to those. Take a look and let me know if the responses hit the mark.

"Recommendations
1. Prior to the arrival on Omelek of any personnel or equipment associated with this project, the north end of the islet should be fenced and signed to prohibit access for the duration of the project, and USAKA or KRS personnel should be on hand to enforce this exclosure during project activities on Omelek. A generalized suggested fence line is indicated on Figure 3."

RESPONSE: USAKA SAYS THAT THE INSTALLATION OF A FENCE IS AN OPERATION AND MAINTENANCE PROBLEM FOR THEM. THE INTENT OF THE RECOMMENDATION SEEMS TO BE TO PROTECT HABITAT. I RECOMMEND THAT WE PUT THE SIGNS UP ALONG THE BOUNDARY YOU SUGGESTED FOR THE FENCELINE AND ALSO ALONG EITHER SIDE OF THE EXISTING ROAD THAT GOES TO THE NORTHERN LAUNCH PADS. THE SIGNS WOULD STATE THAT THIS IS SENSITIVE BIOLOGICAL HABITAT AND IS NOT TO BE DISTURBED AND ASK THAT THEY DON'T GET OFF THE ESTABLISHED ROADS OR OFF ESTABLISHED DISTURBED AREAS AND DO NOT COLLECT OR HARASS THE ANIMALS. ADDITIONALLY, EVERYONE GOING TO OMELEK IS SUPPOSED TO HAVE AN ORIENTATION. AS PART OF THAT ORIENTATION, WE EMPHASIZE THE SENSITIVE NATURE OF THE HABITAT AND THAT THOSE AREAS ARE OFF LIMITS AS MARKED. THOSE ACTIONS, COMBINED WITH VIGILANCE ON MANAGEMENT'S (SPACEX AND USAKA) PART I THINK WILL ACCOMPLISH THE RECOMMENDATION. THESE ACTIONS WOULD BE DESCRIBED IN THE BIOLOGICAL SECTION OF EA CHAPTER 4, ENVIRONMENTAL CONSEQUENCES

Okay, this sounds fine.

"2. The evaporation pond at the launch site will attract seabirds and shorebirds, and if the water tests positive for contaminants, may be a serious hazard to wildlife. If the water contains hazardous materials, it should be pumped out right away and disposed of in accordance with UES protocols (rather than collecting the residue left after the water has evaporated)."

RESPONSE: PAGE 4-9, LINES 10-16 OF THE EA NOW STATE THAT IF TESTS OF THE DELUGE WATER INDICATE PRESENCE OF HAZARDOUS WASTES, THAT WATER WILL BE CONTAINERIZED AND TREATED IN ACCORDANCE WITH THE UES. OTHERWISE IT WILL BE LEFT TO EVAPORATE AND THEN THE RESIDUE WILL BE DISPOSED IN THE KWAJ LANDFILL.

Okay, sounds good.

WE ARE INTERESTED IN DISCUSSING WITH YOU WHY YOU FEEL THAT TEMPORARY EVAPORATIVE PONDS WITH SALINE WATER ARE AN ATTRACTION TO SEA BIRDS IN THIS AREA.

Seabirds and waterfowl like to bathe in ponds, and may not care whether they're fresh or saline. I have observed terns and ducks bathing in salt water as well as in fresh. Shorebirds and reef herons probably will be attracted to forage or investigate forage opportunities around the pond's edge.

"3. Prefabricated buildings and all other materials brought to Omelek should be quarantined on Kwajalein, and inspected and treated if necessary to prevent the introduction of ant species and other non-native organisms that do not now occur on the islet."

RESPONSE: THERE IS NO LOCATION ON KWAJ WHERE EFFECTIVE QUARANTINE CAN OCCUR. THE EA NOW STATES THAT THE EQUIPMENT AND BUILDINGS GOING TO OMELEK (FROM EITHER ROI NAMUR OR KWAJ) WILL BE INSPECTED FOR PEST AND TREATED AS NECESSARY TO RID OF PESTS IMMEDIATELY PRIOR TO RELOCATION TO OMELEK.

Okay, sounds good.

"4. Given the large amount of materials and personnel (up to 30 people) that will be necessary to carry out this project, the actual impacts or "footprint" of the project will extend well beyond the locations of buildings and other infrastructure indicated on the map. The disturbance alone may discourage nesting seabirds, and the possibility exists that the movement of people and materials will result in the introduction of new species to the islet. Furthermore, although some infrastructure will be removed at the conclusion of the project, some, such as the poured concrete, will remain.

A variety of habitat enhancement projects could be undertaken that would provide benefit to the natural environment of Kwajalein Atoll under USAKA jurisdiction to offset the impacts of the SpaceX project on Omelek. Such mitigation could range from conducting experimental trials to control invasive ant species and associated scale insects that may threaten native forests on USAKA islets to assessing the presence of rats on Omelek and nearby USAKA islets and taking appropriate steps to eradicate them and prevent their reintroduction. U.S. Fish and Wildlife Service personnel would be pleased to discuss potential mitigation projects in detail with USAKA, SMDC, SpaceX, and other parties involved in this launch project."

RESPONSE: I SUGGEST THAT WE TRY AN ANT ERADICATION PROGRAM FOR EINEWETAK. USAKA THINKS THAT USE OF ANT BAIT (WHICH IS NONINJUROUS TO CRABS AND OTHER SPECIES) CAN BE USED EFFECTIVELY AND COULD BE EFFICACIOUS IN A RELATIVELY SHORT PERIOD OF TIME. THIS ALSO CAN BE DONE FOR A RELATIVELY SMALL AMOUNT OF MONEY, WHICH IS ATTRACTIVE TO SPACEX, SINCE THEY CURRENTLY ARE LOOKING AT

ONLY TWO SHOTS FROM OMELEK. THIS CAN BE DESCRIBED IN THE BIOLOGICAL SECTION OF EA CHAPTER 4, ENVIRONMENTAL CONSEQUENCES

Yes, I recall Mike talking about this - using jugs of Tero to *control* ants on Eniwetak. This would be an interesting and worthwhile thing to try, but I seriously doubt it would result in the *eradication* of ants from the islet and thus would not have a long-term "mitigative" effect. Eradicating ants from Eniwetak would be an excellent thing to do, and there are specific methods that have been tested elsewhere for doing this. I'm definitely not an ant-eradication specialist (!!), but I did leave a couple of papers with Mike, Ken, and Jack about this, and we can provide you all with names/contact info. for scientists who have been working on Anoplolepis control/eradication.

"5. An option not currently under consideration would minimize impacts to the islet by siting the launch pad well away from the main area of native forest and restricting the "footprint" of the project to a smaller total area in the southern part of the islet. This option would include the use of existing building sites and include removal of decrepit structures from the islet as necessary rather than creating new building sites (even if some of the "new" buildings will be removed at the conclusion of the project). The MAB, for example, could be placed where the gray wood-frame and corrugated metal building is now (near the helipad), and that building could be removed. The launch pad could be placed near where it was placed on the original map in the SpaceX proposal, on or near the site of Building 7428 (see Fig. 1)."

RESPONSE. I THINK THE INTENT OF THIS IDEA IS GREAT AND IT IS EXACTLY WHAT I HAD ASKED YOU TO LOOK FOR...OPTIONS WE HADNT EXPLORED. HOWEVER, GIVEN THE REQUIREMENTS OF THE PROGRAM (WHICH YOU DIDN'T HAVE WHEN YOU WERE DOING YOUR SITE VISIT) FOR COLLOCATION OF THE LOX PLANT AND THE FUEL STORAGE IN CLOSE PROXIMITY TO THE LAUNCH PAD, AND THE REQUIRMENT FOR THE NEW MAB TO BE IN A STRAIGHT LINE ALIGNMENT WITH THE NEW LAUNCH PAD, AND NEED TO THEN REALIGN THE EXISTING ROAD TO THE OLD MAB WOULD ACTUALLY CAUSE US TO HAVE TO REMOVE A GREAT DEAL MORE VEGETATION THAN THE PREFERRED ALTERNATIVE (OPTION 4) OR EVEN OPTION 1. PERSONNALY I DO NOT SEE THIS ALTERNATIVE AS BEING ENVIRONMENTALLY MORE DESIRABLE THAN THE PREFERRED ALTERNATIVE (OPTION 4).

SINCE THIS ALTERNATIVE IS DISCUSSED IN YOUR REPORT AND YOUR REPORT IS APPENDED TO THE EA, WE NEED TO DISPOSE OF IT IN SOME FASHION. FOR REASONS CITED ABOVE, WE DON'T FEEL IT IS AN ENVIRONMENTALLY ADVANTAGEOUS OPTION. ONE WAY TO DO SO IS TO HAVE YOU WITHDRAW IT IN THE USFWS COMMENTS ON THE COORDINATING DRAFT. WHAT IS YOUR OPINION HERE?

Hmmm -- can't you guys simply provide this explanation in your documents, rather than having us withdraw the idea from our comments? We only frame it as an option, anyway, just like the fence.

-----Original Message-----
From: holly_freifeld@r1.fws.gov [mailto:holly_freifeld@r1.fws.gov]
Sent: Thursday, August 26, 2004 8:31 PM
To: Craven, Tom M Mr USASMDC
Cc: Sims, Kenneth Mr. USASMDCK; Michael_Molina@r1.fws.gov
Subject: Re: Omelek Proposed Mitigation/Recommendations

-----Original Message-----
From: John Naughton [mailto:john.naughton@noaa.gov]
Sent: Wednesday, October 06, 2004 4:49 PM
To: Craven, Tom M Mr USASMDC
Cc: 'Akamine, Margaret'; 'michael_molina@fws.gov';
'helene.y.takemoto@poh01.usace.army.mil'; 'Mccarroll.John@epamail.epa.gov';
'Bungitak John'; 'Cannon, Beverly'; Elizabeth Harding (E-mail); Villeneuve,
David J Mr USASMDC; 'Anne Chinnery'; Call, Kevin L Mr USASMDC; Gallien,
Randy Mr USASMDC; Hasley, David C Mr USASMDC; Van Rassen, Cindy M Ms
USASMDC; Sims, Kenneth Mr. USASMDCK; Bill Robinson; Gerry Davis; Tamra Faris
Subject: Re: Coordinating Draft Proof of Principle Space Launches from
Omelek Environmental Assessment

Dear Mr. Craven:

The Habitat Conservation Division, Pacific Islands Regional Office (PIRO) of the National Marine Fisheries Service (NMFS) has reviewed the subject Coordinating Draft Environmental Assessment (EA). The EA was prepared by the U.S. Army Space and Missile Defense Command (SMDC) and examines the potential environmental impacts from the proposed launches of the Falcon Launch Vehicle from Omelek Island, U.S. Army Kwajalein Atoll (USAKA). We offer the following comments for your consideration.

Based on the information in the EA, our knowledge of the proposed project site, and discussions held with you at the recent Annual Review meeting in Huntsville, the PIRO Habitat Division has no objections to the proposed action. It is our understanding that there will be only two launches of the Falcon launch vehicle with satellite payloads from Omelek Island. The only in-water work required at the existing Omelek launch site would be placement of two new mooring buoys in Kwajalein Lagoon immediately west of the small harbor at Omelek Island. Consequently, impacts from the proposed action on marine habitats and associated marine resources at USAKA should be minimal, particularly with adherence to the mitigation measures described in the EA.

The PIRO, Protected Resources Division is also reviewing the subject EA. You should receive their comments shortly under separate cover. NMFS appreciates the opportunity to comment. Should you have any questions, please contact me at PIRO in Honolulu at 808/973-2935x211.

Sincerely,

John Naughton
Pacific Islands Environmental Coordinator
Habitat Conservation Division, PIRO, NMFS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Pacific Islands Regional Office
1601 Kapiolani Boulevard, Suite 1110
Honolulu, Hawaii 96814-0047

OCT 0 8 2004

Mr. Thomas Craven
U.S. Army Space and Missile Defense Command
P.O. Box 1500
Huntsville, AL 35807-3801

RE: Coordinating Draft Environmental Assessment: Proof-of-Principle Space Launches from Omelek Island

Dear Mr. Craven:

This letter responds to your letter received September 3, 2004, regarding the proposed launches of the Falcon Launch Vehicle from Omelek Island, U.S. Army Kwajalein Atoll (USAKA). The letter requests comment on the subject Coordinating Draft Environmental Assessment (DEA). The DEA was prepared by the U.S. Army Space and Missile Defense Command (SMDC) and examines the potential environmental impacts associated with construction, operation, and storage of the Omelek facility for use in the Falcon launches and the potential environmental impacts of the launches themselves.

The National Marine Fisheries Service (NOAA Fisheries) Pacific Islands Regional Office (PIRO) Protected Resources Division (PRD) is charged with implementing statutory authorities under the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. §1531 *et seq.*) and the Marine Mammal Protection Act of 1972 (MMPA), as amended (16 U.S.C. 1361 *et seq.*) and, thus, is authorized to provide comments in this capacity.

Upon review of the EA, the PIRO PRD has no comments on the document. NOAA Fisheries appreciates the opportunity to comment. Should you have further questions regarding this letter, please contact us at (808) 973-2937 or fax (808) 973-2941.

Sincerely,

Tamra Faris
Assistant Regional Administrator
Protected Resources Division

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850
Phone: (808) 792-9400 FAX: (808) 792-9580

TAKE PRIDE IN AMERICA

In Reply Refer To:
PN-04-239

NOV - 3 2004

Jeffrey C. Smith
Colonel, U.S. Army
Deputy Chief of Staff, Engineer
U.S. Army Space and Missile Defense Command
Post Office Box 1500
Huntsville, Alabama 35807-3801

Re: Coordinating Draft Environmental Assessment for Proof of Principle Space Launches from Omelek Islet, U.S. Army Kwajalein Atoll (USAKA)/Ronald Reagan Ballistic Missile Defense Test Site, Republic of the Marshall Islands.

Dear Colonel Smith,

The U.S. Fish and Wildlife Service (Service) has reviewed the Coordinating Draft Environmental Assessment (CDEA) for the above referenced action. The CDEA was prepared by the Department of Defense, U.S. Army Space and Missile Defense Command and sponsored by Space Exploration Technologies, Inc. (SpaceX). The purpose of the proposed action is to develop a facility at Omelek Islet that is capable of launching small, two-stage spacecraft known as Falcon Launch Vehicles (FLVs) into orbit and to test the capability of SpaceX to successfully use the facility to make two proof-of-principle launches of satellite payloads into space, using FLVs.

GENERAL COMMENTS

The CDEA assesses four options to accomplish the proposed action. These options include a Preferred Alternative (Option 4), three other action alternatives, and a No Action Alternative. The environmental impact evaluation for the proposed action is based on information and analyses contained within the CDEA.

We are concerned that the CDEA evaluates the proposed activities and potential impacts to fish and wildlife resources without fully considering the potential for catastrophic failure of the FLV at the launch pad. An accidental explosion of the FLV at the launch pad presents the greatest project-related potential to negatively affect significant fish and wildlife resources on Omelek Islet, as well as those in close proximity to the islet in lagoon and seaward coral reef habitats. In order to fully understand these potential impacts to fish and wildlife resources, we recommend that the DEA identify the outer radius at which fish and wildlife resources may be exposed to and potentially affected by FLV-related fuel and debris in the event a missile accidentally

explodes either in preparation for the launch or during the FLV launch sequence. In addition, we recommend the DEA contain a discussion of proposed measures to avoid, minimize, or compensate for project-related impacts to fish and wildlife resources in the event of a catastrophic failure of an FLV launch.

The CDEA presents an inadequate description of the fish and wildlife resources that occur at Omelek Islet and does not fully analyze potential project-related impacts to these biological resources from implementation of the Preferred Alternative. We recommend replacement of antiquated citations of observations of fish and wildlife resources with more recent information from final reports on the biennial Inventory of Endangered Species and Wildlife Resources at USAKA, which have been produced for the years 1996-2002.

Many activities associated with the proposed action have the capacity to negatively impact migratory bird nesting habitat. Therefore, we recommend that the Preferred Alternative include the provision that construction of support facilities and launch of FLV rockets will be confined to the period between March through August to avoid the primary migratory bird nesting period on Omelek Islet, which occurs during September through February.

SPECIFIC COMMENTS

Page 2-3. Paragraph 1. Line 3: The CDEA states: "The second stage consists of LOX and kerosene tanks with a common bulkhead, and uses helium as a pressurant." The CDEA lacks a clear description of the quantities (*e.g.* second stage) of LOX, kerosene or helium that may stored on the FLV at launch. In order to fully analyze potential impacts to fish and wildlife resources, including impacts from an accidental explosion of a missile prior to or during a launch, we recommend the DEA include a complete description of the quantity of LOX, kerosene or helium that would be loaded onto an FLV for a launch.

Page 2-3. Paragraph 5. Line 32: The CDEA states: "Two new mooring buoys would be added to the lagoon to the west of the two arms forming the harbor at Omelek." The CDEA lacks a description of the potential use of the existing harbor dock to support the Preferred Alternative. We understand that the harbor dock is in a state of disrepair and may be unsafe to use at the present time. If the Preferred Alternative includes refurbishment of the dock to support the landing of project-related supplies, materials, or personnel at Omelek Islet, we recommend that the DEA include a discussion of these proposed harbor uses and an assessment of any proposed activities to restore the dock for this purpose.

Page 2-4. Paragraph 1. Line 1. The CDEA states: "SpaceX would provide up to two 500-kilovolt generators for power on the island, which would be supplied to the various areas required through existing conduits below ground, or via temporary over-ground cable trays." We are concerned that use of the proposed temporary over-ground cable trays may result in negative impacts to migratory bird nesting habitat. Therefore, we recommend that the proposed launches be scheduled to avoid the bird nesting season that may begin as early as September and end in February.

Page 2-4. Paragraph 3. Line18: The CDEA states: "The berm would be of sufficient height to contain up to approximately 7,570 liters (2,000 gallons) of deluge water spray used during launch." Though the CDEA partially describes the quantity of deluge water that would be used during a launch, it does not provide a full description of the berm dimensions and other characteristics (e.g., permeability) of the impoundment feature that would support containment of deluge water spray. We recommend the DEA provide a clear description of the berm/impoundment dimensions and permeability and fully assess the adequacy of this proposed feature to contain the projected amount of deluge water and prevent impacts to fish and wildlife resources.

Page 2-4. Paragraph 4. Lines 22 and 23. The CDEA states: "The water for the deluge system could be supplied from the ocean or from the freshwater brought to the island by SpaceX. If saltwater is used, a temporary floating pump would be placed in the ocean and lines to the spray system on the launch pad would be placed temporarily on the ground for each launch." If a significant quantity of saltwater was released on land, terrestrial vegetation important to migratory birds may be negatively affected and potentially lost due to exposure to large quantities of salt. Also, a temporary floating pump with lines placed on the reef may abrade coral colonies as a result of wave action, causing the loss of coral reef habitat. Therefore, we recommend that the DEA include the provision that freshwater will be used exclusively for deluge water operations. However, significant quantities of freshwater are known to adversely affect coral reef organisms by lowering salinity. Therefore, we further recommend that all freshwater used in deluge operations be contained within the proposed berm/impoundment.

Page 2-4. Paragraph 5. Lines 33 and 34. The CDEA states: "Approximately 35 to 50 percent of the deluge water would be reduced to steam. An evaporative pond would be used to hold the deluge water remaining on the launch pad after launch as well as water used to clean the launch pad before and after launches." Since the deluge water would be used to clean the pad of spent fuel residue, before and after each launch, it is possible that the remaining deluge water could be contaminated with fuels used to launch the FLV. The CDEA does not discuss the length of time necessary for deluge water to evaporate from the ponds nor does it discuss potential concentrations of contaminants that may bind to deluge water molecules. Ponded water is known to attract migratory birds. We are concerned that migratory birds may be attracted to the pond and exposed to lethal or sub-lethal levels of contaminants, resulting in either acute or chronic impacts. Therefore, we recommend the DEA provide a clear description of the risk of exposure that deluge water may present to migratory birds occurring at Omelek Islet.

Page 2-7. Paragraph 2. Line 13. The CDEA states: "Up to 10 SpaceX personnel would live on Omelek." Due to insufficient information in the CDEA, we are unable to fully analyze potential impacts to fish and wildlife resources that may be associated with this residency including: disturbance to and harvest of USAKA Species of Concern, improper disposal of trash, elevation of nutrients and bacteria associated with human waste, and introduction of alien organisms. While the UES should provide safeguards against improper handling of generated waste and debris, we recommend the DEA clearly identify the length of time support personnel will reside at Omelek and include proposed measures that would be implemented to protect fish and wildlife

resources, especially USAKA Species of Concern, from associated impacts. Such measures should at least address the prevention of disturbance or harvest of wildlife and implementation of steps to prevent the introduction of alien species at Omelek Islet.

Page 2-9. Paragraph 4. Line 19: The CDEA states: "The Falcon launch countdown is a 6-hour procedure that would be submitted for USAKA review and approval before implementation." We are concerned that there is no mention in the CDEA of proposed measures to protect USAKA Species of Concern (*e.g.*, sea turtles) found to occur within the radius of impact from launch-related activities. We recommend the DEA describe the methods that will be employed to assess the presence of Species of Concern within the launch impact zone prior to a launch event and include proposed measures that would be implemented to avoid adverse impacts to these species. We recommend that these measures include the postponement of a launch until such organisms have evacuated the area without human assistance.

Page 2-11. Paragraph 2. Line 10: The CDEA states: "A back-out crew would be located at Meck for both mission and abort operations and post-flight operations." Details on the activities that would be undertaken by this crew are not described in the CDEA. We recommend the DEA clearly describe the functions of a back-out crew and assess the potential impacts of these functions to fish and wildlife resources.

Page 2-11. Paragraph 3. Line 14. The CDEA states: "Salt water obtained from the floating pump would be used to douse fires if necessary and for initial cleanup on the pad." We are concerned that the use of large quantities of saltwater to douse fires would result in an excessive build-up of salts, which may negatively affect vegetation and other organisms that occupy the affected soils. Therefore, we recommend that freshwater be used exclusively to douse fires and for project-related cleanup purposes at Omelek Islet.

Page 2-11. Paragraph 3. Lines 19 and 20. The CDEA states: "If contaminants are found, the wastewater would be properly handled and disposed of according to UES requirements. If no contaminants are found, the water would be allowed to evaporate." Migratory birds are highly likely to be attracted to ponded water and may come into contact with the water either through ingestion or dermal contact. We are very concerned that the CDEA does not clearly describe conditions under which deluge water, exposed to fuel and fuel exhaust emitted from the FLV, may be left in place to evaporate in the pond. Therefore, we recommend that the DEA discuss the concentrations of contaminants that may reside in post-launch deluge water and the potential risk of exposure to these contaminants by migratory birds.

Page 3-6. Paragraph 6. Line 34. The CDEA cites an antiquated reference for the observation of the tree *Pisonia grandis* at Omelek. We recommend the DEA include more recent observations of fish and wildlife resources at USAKA, especially Omelek, described in the recently completed report on the 2002 Inventory of Endangered Species and Wildlife Resources at USAKA.

Page 3-8. Figure 3-3. This figure should be updated with the latest species and habitat information provided in the final report on the 2002 Inventory of Endangered Species and Wildlife Resources at USAKA.

Page 3-9. Paragraph 1. The "Wildlife" section in CDEA indicates that *Pisonia* trees and open areas on Omelek are important habitat for certain migratory seabirds and shorebirds. We recommend that the DEA clarify that black and brown noddies and white terns are arboreal species, although brown noddies may roost and nest on the ground, and that the open habitat referred to in this section is habitat for black-naped terns only, not white terns. The DEA should also note that shorebird species observed foraging on Omelek include the Pacific golden plover, wandering and gray-tailed tattlers, ruddy turnstone, whimbrel, and bristle-thighed curlew. The latter species is recognized as a "bird of conservation concern" by the Service. We recommend that information about vegetation and wildlife provided in reports on the 2000 and 2002 Inventory of Endangered Species and Wildlife Resources at USAKA be used in the DEA.

Page. 3-23. Paragraph 4. The CDEA does not provide an adequate description of fish and wildlife resources that occur at Omelek Islet. Therefore, we recommend the DEA describe terrestrial and marine organisms and habitat at Omelek based on information from the final report on the 2002 Inventory of Endangered Species and Wildlife Resources at USAKA.

Page 4-3. Paragraph 3. Line 14. The CDEA states: "Although not currently planned, additional Falcon launches from Omelek could be considered after the proof-of-principle launches have been completed." If additional Falcon launches are proposed, beyond the number of launches identified in this CDEA, we recommend that a draft supplemental environmental assessment be developed to evaluate additional project activity and potential project-related impacts to fish and wildlife resources.

Page 4-5. Paragraph 1. Line 2. The CDEA states: "Impacts to the forest, especially *Pisonia* trees, would be avoided." Since the CDEA does not assess potential project-related impacts to *Pisonia* trees from a catastrophic failure of an FLV launch at the pad, we cannot support this statement. We recommend that the DEA identify the area that may be negatively impacted by such a catastrophic event and describe the fish and wildlife resources that occur within the affected area. Furthermore, we recommend that the DEA identify measures that would be implemented to minimize or, if necessary, compensate for impacts to fish and wildlife resources caused by the catastrophic failure of a missile launch at the pad.

Page 4-5. Paragraph 6. Line 38. The CDEA states: "Siting of the temporary evaporative pond would also avoid impacts on any of the mature, mixed broadleaf forests to the maximum extent practicable." We are unable to fully analyze potential impacts to biological resources in the absence of an identified site for this impoundment at Omelek. Therefore, we recommend the DEA clearly identify the location of the evaporative pond for each proposed alternative.

Page. 4-6 Paragraph 1. Line 8. The CDEA states: " Prior to their arrival on Omelek, SpaceX personnel would be briefed on the need to protect sensitive biological species, including the

remaining forest." In order to protect the remaining forest on Omlelek Islet, we recommend SpaceX personnel be required to use existing roads and paths, including the old road that leads to the north end of the islet through the forest, and that signs be placed at the edge of the forest, prohibiting movement through or access to any part of it. Furthermore, we recommend that on-site supervisors ensure that personnel comply with rules prohibiting movement through or access the forest on Omelek.

Page 4-6. Paragraph 2. Line 12. The CDEA states: "Personnel would be instructed to avoid areas designated as avian nesting or roosting habitat and to avoid all contact with any nest that may be encountered." To ensure that the appropriate areas are identified as nesting or roosting habitat, we recommend coordination with the Service's Pacific Islands Fish and Wildlife Office in Honolulu on the designation of these sites.

Page 4-6. Paragraph 3. Line 16. The CDEA states: "Immediately prior to their shipment to Omelek, prefabricated buildings and all other materials would be inspected and if necessary treated for pests to prevent the introduction of ant species and other non-native organisms." To improve the quality of the inspection, we recommend that a trained wildlife inspector conduct the above referenced inspection. Furthermore, we believe that rodents, such as mice or rats, should be removed from all cargo that is intended to be shipped to Omelek Islet. Therefore, we recommend the sentence be slightly adjusted to read "Immediately prior to their shipment to Omelek Islet, prefabricated buildings and all other materials would be inspected by a qualified wildlife inspector and, if necessary, treated for the removal of pests (*e.g.*, rats, mice and ants) and other non-native organisms, to prevent their potential spread and introduction to other USAKA islets."

Page 4-6. Paragraph 5. Line 29: The CDEA states: "Although construction activities could cause flushing (birds suddenly flying up), this is a common reaction to sudden natural sounds that only slightly increases the energy expenditure of individual birds, and while some wildlife might potentially leave the immediate area permanently, others may likely become accustomed to the increase noise and human presence. Site preparation activities are therefore not expected to have a long-term significant adverse affect on wildlife." We believe that the proposed site preparation activities have the potential to adversely affect wildlife. Human activity near nesting adults can cause these birds to be flushed from or abandon nests during nesting season, potentially resulting in the loss of eggs or chicks to predators, exposure to the elements (*e.g.*, sun or rain), or malnutrition. Therefore, to avoid impacts to migratory bird nests, we recommend that the Preferred Alternative in the DEA include the provision that all construction activities will be conducted during the period when migratory birds do not typically nest at Omelek (*i.e.*, March through August).

Page 4-7. Paragraph 4. Line 36. The CDEA states: "Thus no impacts to nesting or roosting seabirds are expected from operational activities." We cannot support this conclusion since normal launch operations are likely to flush adult birds from their nests, potentially resulting in the temporary or permanent abandonment of the nest. Temporary or permanent abandonment may result in the loss of the nest (*e.g.*, egg or chick) to predators or the harsh environmental

conditions at Omelek Islet. Therefore, we recommend that the Preferred Alternative in the DEA include the provision that all launch activities will be conducted during non-nesting months and that the DEA analyze potential project-related impacts to migratory birds and habitat from a catastrophic failure of a missile on the launch pad at Omelek Islet.

Page 4-7. Paragraph 2. Line 7: The CDEA states: "Harbor improvements and installation of two new mooring buoys at Omelek should cause no localized impact to the coral near the existing jetty; the buoys are designed to minimize impacts to coral, and this potential impact would be further mitigated through careful site planning and construction activities." To avoid significant impacts to healthy coral reefs at Omelek, we recommend that the Preferred Alternative in the DEA include the provision that all components of the mooring buoy (*i.e.*, shackle plate, chain, wire rope, and buoy) will be restricted to the sand habitat immediately fronting the harbor.

Page 4-9. Paragraph 2. Line 6. The CDEA states: "An early flight termination or mishap could result in debris along the flight corridor, which may temporarily impact fishing activities in the immediate area." The CDEA fails to fully evaluate project-related impacts to fish and wildlife resources (*e.g.*, in the event of a catastrophic launch failure at Omelek Islet). Therefore, we recommend the DEA evaluate potential impacts to fish and wildlife resources within the affected area in the event of an accidental explosion during missile preparation and launch.

Page 4-9 line 38: The CDEA states: "An ant eradication project on Eniwetak would be performed." We agree that ant eradication at Eniwetak Islet would improve environmental conditions for nesting seabirds and would serve as appropriate compensation for certain anticipated project-related impacts to migratory bird habitat at Omelek. However, the techniques to eradicate ants at Eniwetak would need to be carefully developed to ensure complete eradication is accomplished. The Service is fully engaged with projects to control ants and other alien species throughout the Pacific and would be available to cooperate on the development of and implementation of methods to eradicate ants and other alien species at Eniwetak Islet. Therefore, we recommend that the DEA address cooperation with the Service to develop and implement methods to eradicate ants and other alien species at Eniwetak.

Page 4-9. Paragraph 2. Line 7: The CDEA states "Due to the small amount of propellant involved and the limited number of launches, the project is not anticipated to adversely affect Essential Fish Habitat or marine resources." We disagree with the conclusion that fuel spills may not have an adverse impact on marine resources. It is well documented that liquid fuel contaminants (*e.g.*, petroleum products) may have acute and severe impacts on marine resources (Ortiz, 1996 and Steel, et. al., 1985). Therefore, we recommend that the DEA identify the contaminants anticipated to result from the launches and present the specific measures that would be used to expeditiously recover accidentally spilled fuel during the launch process at Omelek Islet, thereby avoiding or minimizing negative impacts to marine resources.

Page 4-9. Paragraph 5. Line 29: The CDEA states "Potential soil contamination could occur in the event of an accidental fuel spill or premature flight termination that resulted in burning/unburned fuel coming in contact with soils. Therefore, the risk of accidental fuel spills

during flight test activities would be considered as minor and temporary in duration." We disagree that an accidental release of fuel would always be considered a minor impact to soils at Omelek Islet. Fuel spills, whether released during planned fueling operations or from a catastrophic event, may contaminate soils and the plants and other organisms (*i.e.*, infauna) that inhabit them. Therefore, we recommend that the DEA discuss proposed measures to recover spilled fuels in an expeditious manner, identify measures that would be implemented to prevent future spills, and describe steps that would be undertaken to remediate contaminated habitat, if necessary.

Page 4-12. Paragraph 4. Line 15: The CDEA states "All hazardous materials used and waste generated during site preparation activities would be handled, transported, stored, treated, and disposed of in accordance with the Hazardous Materials Contingency Plan and Hazardous Waste Management Plan prepared by SpaceX." This statement does not clarify what types of hazardous materials will be used in association with the proposed project, what the types of waste may be generated during site preparation activities, and precisely how disposal of these wastes will occur. This information is needed in order to evaluate potential project-related impacts to fish and wildlife resources at Omelek. Therefore, we recommend the DEA clearly identify all types of project-related hazardous materials that may be generated at Omelek Islet and clearly describe the disposal protocols for these materials.

Page 4-13. Paragraph 5. Line 40: The CDEA states "Salt water would be used for initial cleanup of the launch pad." Excessive amounts of salt water may negatively affect vegetated areas at Omelek Islet, which would negatively affect migratory birds. Therefore, we recommend the DEA clearly describe deluge operations and require the use of fresh water to avoid or minimize impacts to vegetated areas.

Page 4-19. Paragraph 4. Line 32: The CDEA states "The resultant sonic boom should not adversely impact any of the surrounding USAKA islands." Although the CDEA identifies the modeled noise levels that may be associated with a FLV, the CDEA does not evaluate FLV-related noise impacts to wildlife, especially migratory birds or sea turtles, which may occur at Omelek Islet. Therefore, we recommend the DEA discuss anticipated project-related noise levels in relation to fish and wildlife resources (*e.g.*, migratory birds) that occur at Omelek Islet.

Page 4-20. Paragraph 7. Line 32. The CDEA states "Although a potential impact to water resources could occur in the event of an accidental fuel spill or premature flight termination that resulted in fuel coming in contact with water resources, fuels would be rapidly buffered by both sea water and the rich calcium carbonate soil preventing any significant adverse impacts." We disagree with this assessment because it omits an evaluation of project-related impacts to ground water at Omelek. It is more likely that fuel spills at the storage facility or launch pad will percolate into the ground and potentially contaminate the islet's groundwater resources. We recommend the DEA clearly discuss the methods that would be implemented to prevent fuel spills and the steps that would be taken to remediate contaminated soils and ground water in the event of an accidental spill or catastrophic missile failure at the launch pad.

SUMMARY

We recommend that the DEA evaluate potential environmental impacts based on the most recent biological information pertaining to the fish and wildlife resources and habitats at Omelek Islet. The DEA should also identify the area that may be affected in the event a missile accidentally explodes either in preparation for the launch or during the FLV launch sequence and contain a discussion of proposed measures to avoid, minimize, or compensate for project-related impacts to fish and wildlife resources in the event of a catastrophic failure of an FLV launch. To reduce the potential for project-related impacts to migratory bird nesting habitat, we recommend that the Preferred Alternative in the DEA include the provision that construction of support facilities and launch of FLV rockets will be confined to the period from March through August to avoid the primary migratory bird nesting period on Omelek Islet, which occurs during September through February. Finally, we recommend the DEA identify other important potential mitigation and conservation measures (e.g., protection from impacts associated with deluge water operations and accidental fuel spills) that would be incorporated into the Preferred Alternative to offset potential project-related impacts to fish and wildlife resources at Omelek Islet.

The Service appreciates the opportunity to comment on the CDEA. If you have any questions regarding these comments, please contact Marine Ecologist Kevin Foster by telephone at (808) 792-9420 or by email (Kevin_b_foster@fws.gov).

Sincerely,

Michael Molina
Acting Field Supervisor

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Ortiz, B.E. 1996. Oil Crisis in Our Oceans – Coral: Roadkill on the Petrohighway. Tageh Press, Glenwood Springs, Colorado. 340 pp.

Steele, John H. 1985. Oil in the Sea – Inputs, Fates and Effects. National Academy Press. Washington D.C. 601 pp.

"Craven, Tom M Mr USASMDC" <Tom.Craven@us.army.mil>
11/10/2004 09:25 AM

To: "'kevin_b_foster@fws.gov'" <kevin_b_foster@fws.gov>, "'michael_molina@fws.gov'" <michael_molina@fws.gov>

cc: Rachel Jordan <JordanR.HV_PO.HV_Domain@edaw.com>, "Sims, Kenneth Mr. USASMDCK" <Kenneth.Sims@usaka.smdc.army.mil>, "'Moon, Rick'" <Rick.Moon@tdytsi.com>, "Villeneuve, David J Mr USASMDC" <david.villeneuve@smdc.army.mil>

Subject: Omelek Space Launch EA - Results of discussions.

Kevin and Michael;

Thanks so much for meeting with us last week and discussing the USFWS comments on the Omelek Space Launch EA. We are working to incorporate your comments as best we can into the EA.

At the meeting, when discussing the comment on seasonal avoidance of activities on Omelek, I mentioned to you that we were not going to be able to commit to activities only during March through August. You guys said you would provide a list of suggestions to minimize effects to nesting birds during nesting season. I am trying to finalize the EA within the next week or so and really need those suggestions to review and incorporate as I am able into the EA. Could you provide those suggestions now?

Also, while discussing the comments on including more recent biological information (e.g., the results of the 2004 report for 2002 inventory), you mentioned that you would revise the habitat map for Omelek that was in the 2004 report to include data collected during this year's inventory field activities. Could that also be provided now for inclusion in the Final EA?

As I mentioned, my schedule is to finalize the EA within the next 2 weeks and put it and the Draft Finding of No Significant Impact out for 30-day public review ASAP. Your provision of the information we discussed last week as soon as possible would be greatly appreciated.

Mahalo,
Tom

>>> <Kevin_B_Foster@r1.fws.gov> 11/29/2004 4:26:39 PM >>>

Tom,

Just back from the USAKA inventory and thanksgiving. Sorry I am late with this reponse.

Yes, you may use the recently revised Omelek map for your EA. John Moran did a fine job making our edits to the map.

If Space X can't conduct the proposed action during the recommended time frame between March through August to avoid migratory bird nesting season, we recommend the following: (1) To the greatest extent practicable, conduct project-related construction activities between March and August; (2) Project-related activities (including construction) that must be conducted during migratory bird nesting season (September - February) should be carried out in areas that avoid identified nesting habitat; and (3) personnel should avoid contact with active nests and avoid flushing adults from nests. In addition, it is possible to set aside the Pisona forest at Eniwetak as compensation for unavoidable impacts to migratory bird habitat at Omelek. The duration of this set aside might be equal to the duration of the Space X project at Omelek, which is an anticipated result of implementation of compensatory mitigation for the proposed MMIII project. Essentially, this would amount to a no disturbance policy and prohibition of unauthorized access to Eniwetak Islet. In the event of a worst case scenario at Omelek (e.g, missile explosion at launch), alien species, such as ants and rodents, would be removed at Eniwetak to offset losses at Omelek.

Please let me know what you think.

Cheers,

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>>> <Michael_Molina@r1.fws.gov> 11/29/2004 5:06:58 PM >>>

Kevin: Just one clarification to the 3rd paragraph in your message to Tom. The 2nd and 3rd to last sentences in this paragraph should read as follows:

"The duration of this set aside might be equal to the duration of the Space X project at Omelek. Essentially, this would amount to a no disturbance policy and prohibition of unauthorized access to Eniwetak Islet, which is an anticipated result of implementation of compensatory mitigation for the proposed MMIII project."

To explain a bit further, we anticipate protection of sea turtle nesting habitat at Enewetak Islet as a NEPA/DEP control that will be applied to MMIII activities proposed at Illeginni Islet during a potential 20-year period. Protection of migratory bird habitat at Enewetak to offset potential Space-X-related impacts to bird habitat on Omelek could also be accomplished. We believe this added protection will be realtively easy to achieve since the framework for conservation at Enewetak Islet will already be established through the DEP process for the MMIII project.

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-----Original Message-----
From: Michael_Molina@r1.fws.gov [mailto:Michael_Molina@r1.fws.gov]
Sent: Tuesday, December 07, 2004 8:53 AM
To: cravent@smdc.army.mil
Cc: Kevin_B_Foster@r1.fws.gov
Subject: Space-X DEA

Tom:
Thanks for forwarding the table summarizing USAKA's responses to our comments on the Space-X DEA. In addition, I appreciate your willingness to set up a telecon for us to go over those responses. Based on the responses in that table and on the resolutions we arrived at during the telecon discussion we had last week on a couple of remaining issues, we feel our primary concerns have now been adequately addressed. Provided that all of these agreed upon resolutions are incorporated into the proposed Space-X project and reflected in the Final EA, we would support a FONSI determination for the project.

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APPENDIX C
OMELEK ISLET TRIP REPORT

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OMELEK ISLET TRIP REPORT

Omelek Islet Missile Launch Project, U.S. Army, Kwajalein Atoll (USAKA)
Trip report – Holly Freifeld, U.S. Fish and Wildlife Service

Background

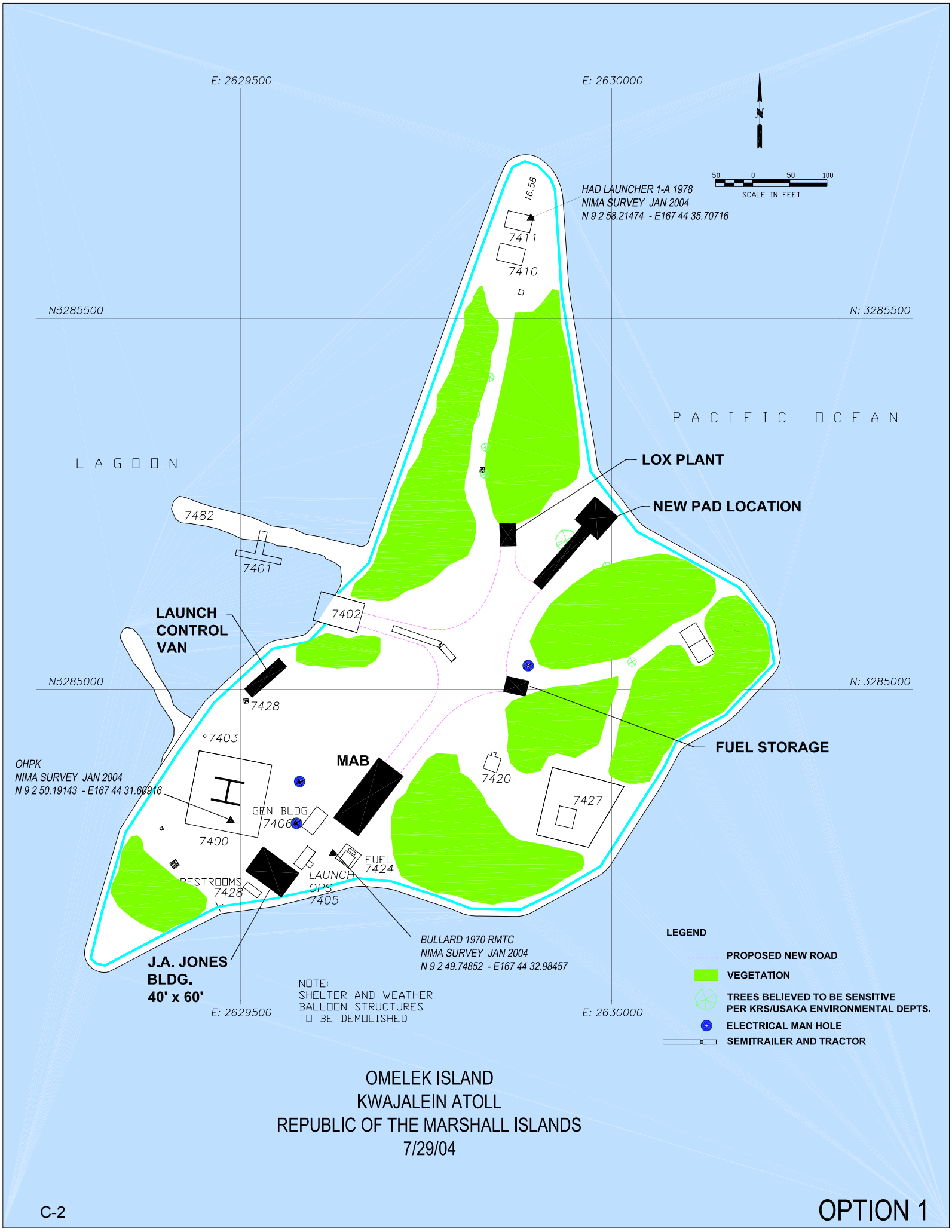
As requested by USAKA, I visited Omelek Islet on June 30, 2004 to review the proposed sites for new infrastructure in support of the "Concept of Operations USAKA Launch" project proposal by Space Exploration Technologies, Inc. (SpaceX). I was accompanied by Mr. Ken Sims, Chief, USAKA Environmental Management Office; Ms. Suzanne Pyle, Kwajalein Range Services (KRS) Environmental Office; and Mr. Mike Nicholson, KRS Pest Management Office.

Up to 30 people may be on-island for construction of the launch pad and installation of buildings; as many as 10 personnel may be housed on Omelek during the project. The options in the SpaceX proposal (for Option 1, see Fig. 1) indicate that existing non-forested areas will be used for the project; the various options distribute the same buildings and infrastructure slightly differently on the islet. Construction will include pouring concrete for a 4,000 ft^2 pad for the missile assembly building (MAB), a 1,600 ft^2 launch pad, and pads for a truck, the liquid oxygen (LOX) plant, and fuel storage tanks of indeterminate size. One building will be transported from another islet; another will be constructed on-site, and some of the existing buildings on Omelek will be refurbished. Several supply containers also will be brought to the islet, as well as two large generators and a fuel storage tank.

Fires will be prevented by a deluge system that will pump seawater to the site during and following the launch. Seawater pumped in for deluge and rinse purposes will be cached in a pond lined with an impermeable liner and bermed with sandbags (approximately 338 ft^3 in size) until the water evaporates, and this water will be tested for contaminants (T. Craven, SMDC, personal communication). The residue will be collected and disposed of as appropriate depending upon results of contaminants testing. Substances including kerosene, diesel, liquid oxygen, liquid nitrogen, and helium will be stored and used on Omelek as part of this project, and USAKA emergency protocols will be followed in the event of a spill (*e.g.*, of kerosene or diesel). To the best of our understanding, the impact radius for these launches is approximately 50 to 100 ft. The prefabricated building and other movable components will be removed from Omelek when the project is complete. An environmental assessment of this project under the National Environmental Policy Act is in preparation.

Field excursion and results

We arrived at Omelek at approximately 0830 and departed at approximately 1100. The four of us walked the islet, and Mr. Sims indicated proposed locations for the launch pad, LOX plant, fuel storage building, MAB, launch control van, and other infrastructure according to Options 1 and 4 in the SpaceX proposal document. I noted the configuration of grass/forb and forest vegetation with respect to the proposed project sites, the presence of native and non-native plants and of vertebrate species (Tables 1, 2, and 3). Mr. Nicholson observed various non-native insects on Omelek, notably the pink hibiscus mealy bug, big-headed ant (not reported by Preston [2003]), Formosan termite, and a *Polestes* wasp that he had collected previously and given to Kevin Foster (USFWS) to be identified. The crabs present on the island were not identified to species, but hermit and purple land crabs were abundant.



OMELEK ISLAND
KWAJALEIN ATOLL
REPUBLIC OF THE MARSHALL ISLANDS
7/29/04

OPTION 1

Based on our on-the-ground revision of maps included in the SpaceX proposal document, and the official revision of that map (Fig 1 – attached .pdf), I created a rough schematic of the proposed infrastructure for the project, and general delineation of significant vegetation and vegetation likely to be affected by this project, overlaid on a photo of the islet (Fig. 2 - below).

Areas in Figure 2 labeled "1" are grass and forb vegetation maintained at a low level by mowing or other mechanical control. Species encountered in these open areas include a mix of native and non-native plants (Table 1). Left untended, these areas develop a cover up to approximately one meter in height, dominated by *Vigna*, *Bidens*, and *Ipomoea*. The project infrastructure will be placed primarily in these (already significantly disturbed) areas.

Table 1. Dominant plants observed in open areas (maintained by mowing) on Omelek

Scientific name*	Common name	Status
Vigna marina	Beach pea	Native
Ipomoea pes-caprae	Beach morning glory	Native
Ipomoea macrantha	[white morning glory]	Native
Bidens alba	Beggar's tick	Non-native
Heliotropium procumbens?	Heliotrope	Non-native (?)
Triumfetta procumbens	---	Native
Cassytha filiformis	---	Native
Phyla sp.**	---	Non-native
Phyllanthus sp.	---	Non-native
Cenchrus sp.	Sand bur	? (depends on species)
Lepturus repens	(grass)	Native
[Various Poaceae]	[grasses]	Native & Non-native
Fimbristylis sp.	Sedge	Native

*Nomenclature follows Whistler 1992, 1994.
** Identified by Cheryl Phillipson, USFWS (pers. comm., 2004), from photograph

Areas labeled "2" in Figure 2 are forest vegetation. These areas are dominated by native trees and shrubs. The understory is composed predominately of saplings and seedlings of the canopy species, with a small component of morning glory vines and ground-layer non-native species. Vegetated areas not identified as 1 or 2 in Figure 2 are shrubby vegetation dominated by *Scaevola taccada* and *Tournefortia argentea*.

Table 2. Dominant species in forest vegetation on Omelek.

Scientific name*	Common name	Status
Tournefortia argentea	Beach heliotrope	Native
Pisonia grandis	Pisonia	Native
Cocos nucifera	Coconut	Native (?)
Neisosperma oppositifolium	---	Native
Guettarda speciosa	---	Native
Morinda citrifolia	Noni	Native

Table 2., continued.

Scientific name*	Common name	Status
Scaevola taccada	---	Native
Ipomoea macrantha &/or littoralis	Morning glory	Native
Phyllanthus sp.	---	Non-native
[Various Poaceae]	[grasses]	Native & Non-native

*Nomenclature follows Whistler 1992, 1994.

Table 3. Vertebrate species noted on Omelek.

Scientific name*	Common name	Status
[Birds]		
Egretta sacra	Reef heron (1, white phase)	Native
Heteroscelus incanus	Wandering tattler (2, heard only)	Native
Gygis alba	White tern (at least 4 individuals, apparently prospecting in forest)	Native
Sterna sumatrana	Black-naped tern (up to six, roosting on dock)	Native
Anous stolidus	Brown noddy (up to three flying along shore of islet, one carrying nesting material)	Native
[Reptiles]		
Emoia cyanura or *E. caeruleocauda*	Azure-tailed or Blue-tailed skink (common in forest)	Native
*Gehyra oceanica***	Island gecko (three individuals seen inside old building)	Native

*Nomenclature follows Pratt *et al.*, 1987.
** Identified by Earl Campbell, USFWS (pers. comm., 2004), from photograph.

Based on our field review of sites for buildings and infrastructure in Options 1 and 4 of the SpaceX proposal, and Mr. Sims' more detailed verbal description of proposed plans for siting structures, this project is not likely to result in the removal of large amounts of native vegetation. Some *Scaevola* and *Tournefortia* will be removed to enlarge existing open sites, for example, the site for the J.A. Jones building in Option 4 and the site for the launch pad. However, at least 6,000 to 7,000 square feet of new concrete will result in the more or less permanent removal of that area as habitat available for nesting seabirds or foraging shorebirds on Omelek. This is not an immediate, direct effect on migratory birds, but it is a long-term impact on the quality of the islet's habitat for these species.

The site identified for the launch pad in Figure 1 is adjacent to the largest patch of native forest on the islet (north and west of the site), and another patch of native forest occurs immediately south of the site. Sufficient open space apparently exists at that site to absorb the impacts on the ground of a launch (if those impacts are limited to within 50 ft of the pad or so). The layout of buildings and infrastructure sketched in Figure 1 does not, overall, minimize impacts to the island's natural environment to the greatest extent possible. Nevertheless, this layout will not result in the removal of major amounts of native vegetation, nor will it result in direct effects to migratory birds other than disturbance during the project itself.

Recommendations

1. Prior to the arrival on Omelek of any personnel or equipment associated with this project, the north end of the islet should be fenced and signed to prohibit access for the duration of the project, and USAKA or KRS personnel should be on hand to enforce this exclosure during project activities on Omelek. A generalized suggested fence line is indicated on Figure 3.

2. The evaporation pond at the launch site will attract seabirds and shorebirds, and if the water tests positive for contaminants, may be a serious hazard to wildlife. If the water contains hazardous materials, it should be pumped out right away and disposed of in accordance with UES protocols (rather than collecting the residue left after the water has evaporated).

3. Prefabricated buildings and all other materials brought to Omelek should be quarantined on Kwajalein, and inspected and treated if necessary to prevent the introduction of ant species and other non-native organisms that do not now occur on the islet.

4. Given the large amount of materials and personnel (up to 30 people) that will be necessary to carry out this project, the actual impacts or "footprint" of the project will extend well beyond the locations of buildings and other infrastructure indicated on the map. The disturbance alone may discourage nesting seabirds, and the possibility exists that the movement of people and materials will result in the introduction of new species to the islet. Furthermore, although some infrastructure will be removed at the conclusion of the project, some, such as the poured concrete, will remain.

A variety of habitat enhancement projects could be undertaken that would provide benefit to the natural environment of Kwajalein Atoll under USAKA jurisdiction to offset the impacts of the SpaceX project on Omelek. Such mitigation could range from conducting experimental trials to control invasive ant species and associated scale insects that may threaten native forests on USAKA islets to assessing the presence of rats on Omelek and nearby USAKA islets and taking appropriate steps to eradicate them and prevent their reintroduction. U.S. Fish and Wildlife Service personnel would be pleased to discuss potential mitigation projects in detail with USAKA, SMDC, SpaceX, and other parties involved in this launch project.

5. An option not currently under consideration would minimize impacts to the islet by siting the launch pad well away from the main area of native forest and restricting the "footprint" of the project to a smaller total area in the southern part of the islet. This option would include the use of existing building sites and include removal of decrepit structures from the islet as necessary rather than creating new building sites (even if some of the "new" buildings will be removed at the conclusion of the project). The MAB, for example, could be placed where the gray wood-frame and corrugated metal building is now (near the helipad), and that building could be removed. The launch pad could be placed near where it was placed on the original map in the SpaceX proposal, on or near the site of Building 7428 (see Fig. 1).

References cited

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Whistler, W.A. 1992. Flowers of the Pacific Island seashore. Isle Botanica, Honolulu, Hawaii. 154 pp.

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Figure 2. Approximate location of new infrastructure for SpaceX USAKA launch project on Omelek Islet and general vegetation types (based on Option 4).

Figure 3. Recommended fence line (general, in solid blue) to reduce disturbance of native forest habitat.

ACRONYMS AND ABBREVIATIONS

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ARTCC	Air Route Traffic Control Center
CFR	Code of Federal Regulations
dB	decibel
dBA	A-weighted decibel
DoD	Department of Defense
EA	Environmental Assessment
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
FL	Flight Level
ICAO	International Civil Aviation Organization
LOX	Liquid Oxygen
MAB	Missile Assembly Building
µg/m^3	micrograms per cubic meter
µPa	micropascal
NEPA	National Environmental Policy Act
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
RCC	Range Commanders Code
RF	radiofrequency
RMI	Republic of the Marshall Islands
ROI	Region of Influence
SpaceX	Space Exploration Technologies, Inc.
THAAD	Theater High Altitude Area Defense
UES	United States Army Kwajalein Atoll Environmental Standards
USAKA/RTS	United States Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site
USASMDC	United States Army Space and Missile Defense Command